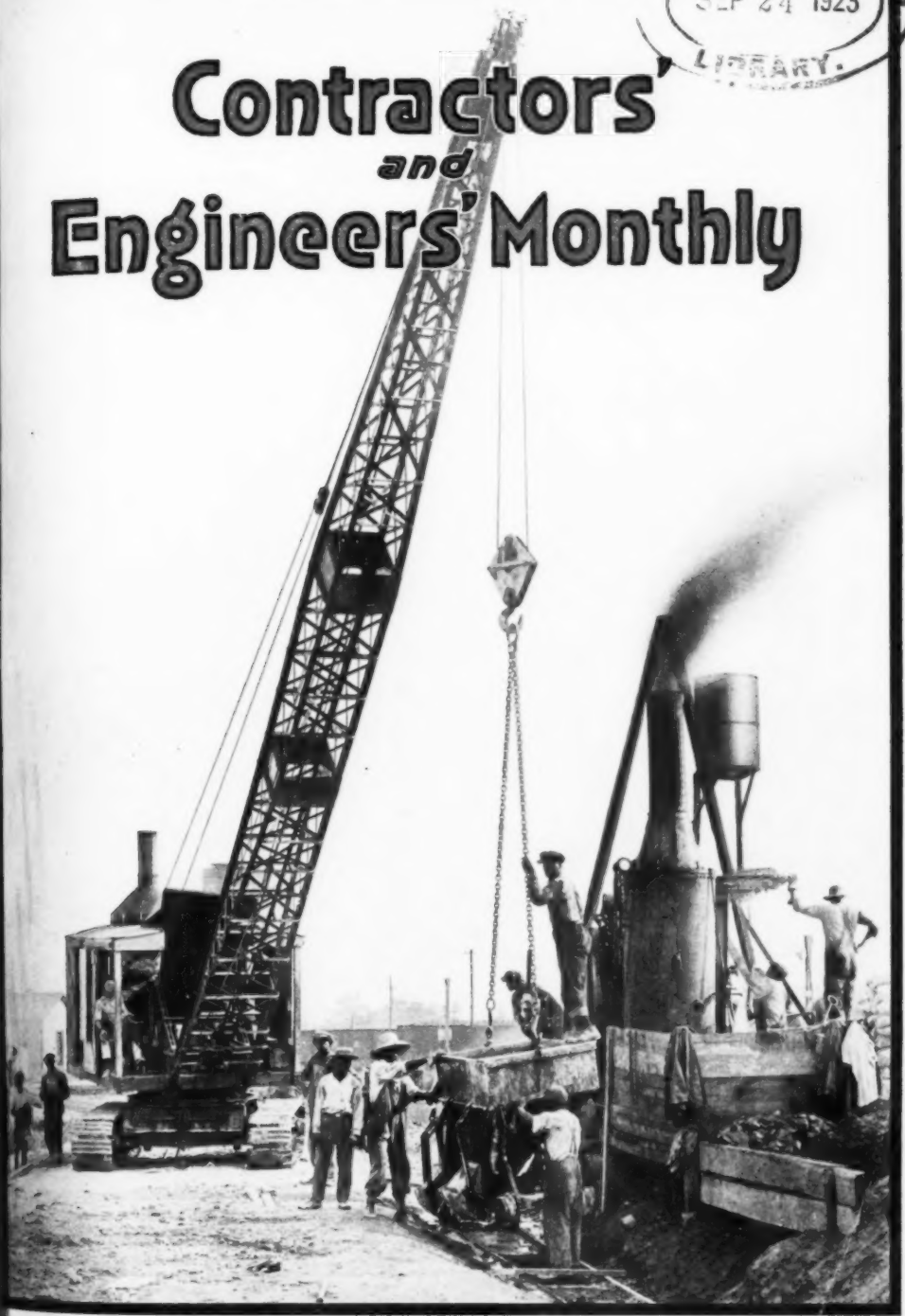
Contractors and Engineers' Monthly



Excavator with ¾-Yard Bucket and 50-Foot Boom Owned by Sanford & Brooks, Baltimore, Md.

September, 1923 25 Cents $1 a Year

VOL. VII. NO. 3 CONTRACTORS' & ENGINEERS' MONTHLY SEPTEMBER, 1923
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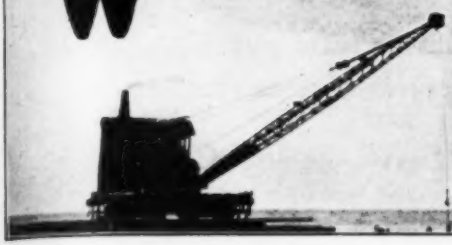
Where to Purchase



A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

ACETYLENE
Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS
Air Reduction Sales Co., New York.
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES. (See Calculating Machines.)

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
De La Vergne Machine Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
General Electric Co., Schenectady, N. Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm, Inc., West Chester, Pa.
Sullivan Mchy. Co., Chicago, Ill.
United Iron Works, Kansas City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., New York.

ARC LAMPS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARTESIAN WELL DRILLS AND PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS PRODUCTS
*Carey Co., Philip, Cincinnati, Ohio.
Darcoid Co., Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Mikesel Bros. Co., Chicago, Ill.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago, Ill.

ASH HANDLING MACHINERY
*Haiss Mfg. Co., Geo., New York.
*International Motor Co., New York.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland O.
Bay City Dredge Wks., Bay City, Mich.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Eng. Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

ASPHALT PRODUCERS
*Barber Asphalt Co., Philadelphia, Pa.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
*Warren Bros. Co., Boston, Mass.
Atlantic Refining & Asphalt Corp., Phila., Pa.
Barrett Co., New York.
Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
Ky. Rock Asphalt Co., Louisville, Ky.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
Standard Oil Co. of N. Y., New York.
U. S. Asphalt Refining Co., New York.

ASPHALT BLOCK
Hastings Pavement Co., New York.

ASPHALT CUTTERS
Dayton Pneumatic Tool Co., Dayton, Ohio.
Chicago Pneumatic Tool Co., New York
Ingersoll-Rand Co., New York.

ASPHALT KETTLES. (See Kettles for Asphalt and Tar Heating.)

ASPHALT PLANTS, TOOLS, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Philadelphia, Pa.
*Warren Bros. Co., Boston, Mass.
Austin Machinery Corp'n, Toledo, O.
Bacon Co., Edw. R., San Francisco, Cal.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT ROLLERS. (See Road and Paving Rollers.)

ASPHALT SURFACE HEATERS
*Barber Asphalt Co., Philadelphia, Pa.
*Equitable Asphalt Maint. Co., Kansas City, Mo.
Hauck Mfg. Co., Brooklyn, N. Y.

BACKFILLERS
*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Constr. Mchy. Co., Waterloo, Ia.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Weller Mfg. Co., Chicago, Ill.

BAR BENDERS AND CUTTERS
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.
Mckenna Co., Cleveland, Ohio.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., New York.
Universal Form Clamp Co., Chicago, Ill.

BARS, IRON AND STEEL
Aborn Steel Co., Inc., New York.
Ames & Co., W., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.

Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.
Sweet's Steel Co., Williamsport, Pa.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
United Alloy Steel Corp., Canton, Ohio.

BELTING, RUBBER

*Goodrich Rubber Co., B. F., Akron, O.
*Robins Conv. Belt Co., New York.
Allen Mfg. Co., W. D., Chicago, Ill.
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Fairbanks Co., The, New York.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, O.
Mulconroy Co., Inc., Philadelphia, Pa.
Republic Rubber Co., Youngstown, Ohio.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
U. S. Rubber Co, New York.
Voorhees Rubber Mfg. Co., Jersey City, N. J.

BINS, STORAGE

*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Ransome Concrete Mach. Co., Dunnellen, N. J.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Fairfield Engineering Co., Lancaster, Ohio.
Green Engineering Co., E. Chicago, Ind.
Link-Belt Co., Chicago, Ill.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Weller Mfg. Co., Chicago, Ill.

BLAST HOLE DRILLING MACHINES. (See "Well Drilling and Blast Hole Machines")

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE

Boston & Lockport Block Co., East Boston, Mass.
Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., New York.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Spencer Turbine Co., Hartford, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

BLOWPIPES

Oxweld Acetylene Co., Newark, N. J.

BLUE PRINT MACHINES

Dietzgen Co., Eugene, Chicago, Ill.
Keuffel & Esser Co., Hoboken, N. J.
Pease Co., C. F., Chicago, Ill.
Weber & Co., F., Philadelphia, Pa.
Wickes Bros., Saginaw, Mich.

BLUE PRINT AND TRACING PAPERS

Indianapolis Blue Print & S'ply Co., Ind'apolis.
Kolesch & Co., New York.

BOILERS

Abendroth & Root Mfg. Co., Newburgh, N. Y.
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., New York.
Biggs Boiler Wks., Akron, Ohio.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Erie City Iron Works, Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ladd Co., Geo. T., Pittsburgh, Pa.
Leffel & Co., J., Springfield, O.
Lord & Burnham Co., Irvington, N. Y.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES

American Screw Co., Providence, R. I.
American Spike Co., New York.
Ames, W. & Co., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Bolt Co., Buffalo, N. Y.
Clark Bros. Bolt Co., Millidale, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Foster Bolt & Nut Mfg. Co., Cleveland, Ohio.
Inland Steel Co., Chicago, Ill.
Lamson & Sessions Co., Cleveland, Ohio.
Maryland Bolt & Forge Co., Baltimore, Md.
Milton Mfg. Co., Milton, Pa.
Neely Nut & Bolt Co., Pittsburgh, Pa.
Oliver Iron & Steel Corp'n, Pittsburgh, Pa.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Bursdall & Ward Co., Port Chester, N. Y.
St. Louis Screw Co., St. Louis, Mo.
Scranton Bolt & Nut Co., Scranton, Pa.
Star Exp. Bolt Co., New York.
Sweet's Steel Co., Williamsport, Pa.

BRACES, TRENCH

Channon Mfg. Co., Jas. H., Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Kalamazoo Fdry. & Mach. Co., Kalamazoo, Mich.
Waldo Bros. & Bond Co., Boston, Mass.

BRASS GOODS

*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Have Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
United Brass Mfg. Co., Cleveland, O.

BREAKERS, CONCRETE

Buckeye Traction Ditcher Co., Findlay, O.
Ingersoll-Rand Co., New York City

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL

*Frederick Snare Corporation, New York.
American Bridge Co., New York.
Bellefontaine Bridge & Steel Co., Bellefontaine, O.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Chicago Bridge & Iron Works, Chicago, Ill.
Clinton Bridge Wks., Clinton, Iowa.
Eastern Bridge & Struc. Co., Worcester, Mass.
Flour City Orn. Iron Co., Minneapolis, Minn.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Ingalls Iron Works Co., Birmingham, Ala.
Inter. Steel & Iron Co., Evansville, Ind.
Lewis-Hall Iron Wks., Detroit, Mich.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.
Minn. Steel & Mchy. Co., Minneapolis, Minn.

Missouri Vy. Bdge. & Iron Co., Leavenworth, Kan.
Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis

BRONZE TABLETS

Flour City Orn. Iron Co., Minneapolis, Minn.
Imperial Brass Mfg. Co., Chicago, Ill.
Mott Iron Wks., J. L., New York

BROOMS, HAND FOR STREET CLEANING, ETC.

Holcomb Mfg. Co., J. I., Indianapolis, Ind.
Ind. Brush & Broom Mfg. Co., Indianapolis, Ind.
Kendallville Broom & Brush Co., Kendallville, Ind.
Lay Co., Jos., Ridgeville, Ind.
Milwaukee Brush Mfg. Co., Milwaukee, Wis.
Osborn Mfg. Co., Cleveland, Ohio.

BUCKETS, AUTOMATIC DUMPING

*Littleford Bros., Cincinnati, O
Lakewood Engineering Co., Cleveland, O.
Stuebner Iron Works, G. L., Long Island City,

BUCKETS, CLAM SHELL

*Haiss Mfg. Co., Geo., New York.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Coleman Co., F. A., Cleveland, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Owen Bucket Co., Cleveland, Ohio
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Rochester Can Co., Rochester, N. Y.
Insley Mfg Co., Indianapolis Ind
Lakewood Engineering Co., Cleveland, O.
Smith Co., T. L., Milwaukee, Wis.
Union Iron Works, Inc., Hoboken, N. J.
Weller Mfg. Co., Chicago, Ill.

BUCKETS, DRAGLINE

*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Monighan Machine Co., Chicago, Ill.

BUCKETS, DREDGING AND EXCAVATING

*Haiss Mfg. Co., Inc., Geo., New York.
Austin Machinery Corp'n, Toledo, O.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mach. Co., Cleveland, O.
Browning Co., Cleveland, O.
Hayward Co., New York.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Eng. Co., Cleveland, O.
Mead-Morrison Mfg Co., East Boston, Mass.
Owen Bucket Co., Cleveland, Ohio.
Williams Co., G. H., Erie, Pa.

BUCKETS, ORANGE PEEL

Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.

BUILDERS' HARDWARE

Corbin, P. & F., New Britain, Conn.
Reading Hardware Co., Reading, Pa.
Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Co., New Haven, Conn.
Stanley Works, New Britain, Conn.
Yale & Towne Mfg. Co., New York.

BUILDINGS, STEEL (See Bridges and Buildings)

BUNKS AND COTS

Fort Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago, Ill.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS

*Sauerman Bros., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Roebling Sons Co., J. A., Trenton, N. J
Street Bros. Mach. Wks., Chattanooga, Tenn.
Waterbury Co., New York.

CAISSONS

American Bridge Co., New York.
Foundation Co., New York.
Bethlehem Steel Co., Bethlehem, Pa.
O'Rourke Eng. Constr. Co., New York.
Petroleum Iron Works Co., Sharon, Pa.

CALCIUM CHLORIDE FOR ROADS

*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., Solvay, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

CALCULATING MACHINES

Burroughs Adding Machine Co., Detroit Mich
Dalton Adding Mach. Co., Cincinnati, O.
Felt & Tarrant Mfg. Co., Chicago, Ill.
Marchant Calc. Machine Co., Oakland, Cal.
Monroe Calculating Machine Co., Orange, N. J

CANS FOR GARBAGE AND STREET REFUSE

*Littleford Bros., Cincinnati, O.
*Rochester Can Co., Rochester, N. Y.
American Can Co., New York.
Butler Mfg. Co., Minneapolis, Minn.
Economy Baler Co., Ann Arbor, Mich.
Safety Sanitary Rubbish Box Co., Columbus O
Solar-Sturges Mfg. Co., Chicago, Ill.
Steel Basket Co., Cedar Rapids, Iowa.

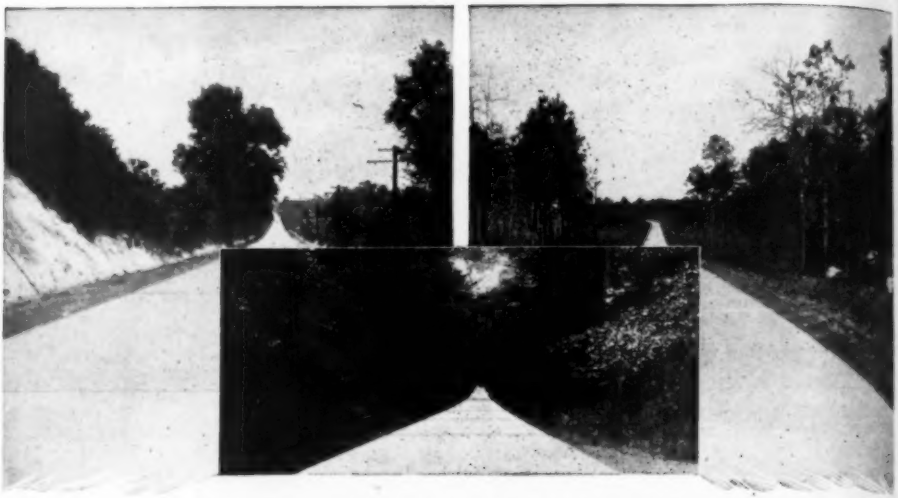
CARS, INDUSTRIAL V. DUMPING

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Austin Machinery Corp'n, Toledo, O.
Atlas Car & Mfg. Co., Cleveland, O.
Chase Fdry. & Mfg. Co., Columbus, O
Easton Car & Constr. Co., New York.
Hunt Co., C. W., W. New Brighton, N. Y.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Light Ry. Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Stuebner Iron Works, G. L., L. I. City, N. Y
United Iron Works, Kansas City, Mo.
Weller Mfg. Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

CARTS, CONCRETE

*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O
Lee Trailer & Body Co., Chicago, Ill.
Smith Co., T. L., Milwaukee, Wis.
Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE (See Pipe, Cast Iron)



Left—Savannah-Augusta, Ga., road. Dixon Contracting Co., Savannah, Ga., Builders. *Right*—Newberry Road, Richland County, Columbia, S. C. Constructed by Chatham Paving Co., Columbia, S. C. *Center*—Ogeechee Road leading from Savannah, Ga., W. T. Hadlow, Jacksonville, Fla., Builder.

CASTINGS, STREET AND SEWER

*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
Canton Foundry & Machine Co., Canton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Dee Co., W. E., Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Foundry Mfg. Co., St. Albans, Vt.
Klauer Mfg. Co., Dubuque, Iowa.
Madison Foundry Co., Cleveland, O.
Pechstein Iron Works, Keokuk, Ia.
Sessions Foundry Co., Bristol, Conn.
South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

CATCH BASIN CLEANING APPARATUS

*International Motor Co., New York.
Elgin Sales Corp., New York.

CAULKING MACHINERY AND TOOLS

Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

CEILINGS, METAL

Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Newport Rolling Mill Co., Newport, Ky.
Klauer Mfg. Co., Dubuque, Iowa.
Mesker & Co., Geo. L., Evansville, Ind.
Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

CEMENT

*Pennsylvania Cement Co., New York
Ætna Portland Cement Co., Detroit, Mich.
Allentown Portland Cement Co., Allentown, Pa.
Alpha Portland Cement Co., Easton, Pa.
Ash Grove Lime and Portland Cement Co., Kansas City, Mo.
Atlas Portland Cement Co., New York.
Bath Portland Cement Co., Philadelphia, Pa.
Beaver Portland Cement Co., Portland, Ore.
Bessemer Limestone and Cement Co., Youngstown, O.
Bonner Portland Cement Co., Kansas City, Mo.
Canada Cement Co., Ltd., Montreal, Canada.
Cape Girardeau Portland Cement Co., Cape Girardeau, Mo.
Castalia Portland Cement Co., Pittsburgh, Pa.
Clinchfield Portland Cement Corp., Kingsport, Tenn.
Colorado Portland Cement Co., Denver, Colo.
Continental Portland Cement Co., St. Louis, Mo.
Coplay Cement Manufacturing Co., Coplay, Pa.
Cowell Portland Cement Co., San Francisco, Cal.
Crescent Portland Cement Co., Wampum, Pa.
Dewey Portland Cement Co., Kansas City, Mo.
Dexter Portland Cement Co., Nazareth, Pa.
Diamond Portland Cement Co., Cleveland, Ohio.
Dixie Portland Cement Co., Chattanooga, Tenn.
Edison Portland Cement Co., New York.
Fredonia Portland Cement Co., Fredonia, Kans.
Giant Portland Cement Co., Philadelphia, Pa.
Gilmore Portland Cement Corp., Gilmore City, Iowa.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Golden State Portland Cement Co., Los Angeles, Cal.
Gulf States Portland Cement Co., Demopolis, Ala.
Hawkeye Portland Cement Co., Des Moines, Ia.
Helderberg Cement Co., Albany, N. Y.
Hercules Cement Corp., Philadelphia, Pa.
Indiana Portland Cement Co., Indianapolis, Ind.
International Portland Cement Co., Ltd., Spokane, Wash.
Knickerbocker Portland Cement Co., Inc., New York.
Kosmos Portland Cement Co., Louisville, Ky.
Lawrence Portl'd Cement Co., Northampton, Pa.
Lehigh Portland Cement Co., Allentown, Pa.
Louisville Cement Co., Louisville, Ky.
Marquette Cement Mfg. Co., Chicago, Ill.
Missouri Portland Cement Co., St. Louis, Mo.
Monarch Cement Co., Humboldt, Kans.
Nazareth Cement Co., Nazareth, Pa.
Newaygo Portland Cement Co., Newaygo, Mich.
Nebraska Cement Co., Denver, Colo.
New Egyptian Portland Cement Co., Fenton, Mich.
New York & New England Cement & Lime Co. New York.
Northwestern States Portland Cement Co., Mason City, Ia.
Ogden Portland Cement Co., Ogden, Utah.
Oklahoma Portland Cement Co., Denver, Colo.
Old Mission Portland Cement Co., San Francisco, Cal.
Olympic Portl'd Cement Co., Ltd., Seattle, Wash.
Oregon Portland Cement Co., Portland, Ore.
Pacific Portland Cement Co., San Francisco, Cal.
Peerless Portland Cement Co., Union City, Mich.
Peninsular Portland Cement Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey Portland Cement Co., Petoskey, Mich.
Phœnix Portland Cement Co., Nazareth, Pa.
Portland Cement Co. of Utah, Salt Lake City, Utah.
Pyramid Portland Cement Co., Des Moines, Ia.
Riverside Portl'd Cement Co., Los Angeles, Cal.
San Antonio Portland Cement Co., San Antonio, Tex.
Sandusky Cement Co., Cleveland, Ohio.
Santa Cruz Portland Cement Co., San Francisco, Cal.
Security Cement and Lime Co., Hagerstown, Md.
Signal Mountain Portland Cement Co., Chattanooga, Tenn.
Southern States Portland Cement Co., Rockport, Ga.
Southwest'n Portland Cement Co., El Paso, Tex.
Standard Portland Cement Corp., San Francisco, Calif.
Superior Portland Cement Co., Seattle, Wash.
Texas Portland Cement Co., Dallas, Tex.
Three Forks Portland Cement Co., Denver, Colo.
Tidewater Portland Cement Co., Baltimore, Md.
Trinity Portland Cement Co., Dallas, Tex.
Union Portland Cement Co., Ogden, Utah.
United States Potash Co., Los Angeles, Cal.
U. S. Portland Cement Co., Denver, Colo.
Universal Portland Cement Co., Chicago, Ill.
Vulcanite Portland Cement Co., Philadelphia, Pa.
Wabash Portland Cement Co., Detroit, Mich.
Wellston Iron Furnace Co., Jackson, Ohio.
Western States Portland Cement Co., Independence, Kans.
Whitehall Cement Mfg. Co., Philadelphia, Pa.
Wolverine Portl'd Cement Co., Coldwater, Mich.
Wyandotte Portland Cement Co., Detroit, Mich.

CEMENT GUNS

Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CHAINS

American Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Niagara Metal Stamp Corp., Niagara Falls, N. Y.
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CHECK VALVES

*Ludlow Valve Mfg. Co., Troy, N. Y.
Columbian Iron Works, Chattanooga, Tenn.
Lunkenheimer Co., Cincinnati, O.
Mueller Mfg. Co., H., Decatur, Ill.

CHEMICALS FOR WATER PURIFICATION

Du Pont de Nemours & Co., E. I., Wilmington, Del.
Electro Bleaching Gas Co., New York.
General Chemical Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

These Self-Dumpers—10 of a fleet of 25 purchased by the Indiana State Highway Commission—are building a 10-mile section of the state road between Huntingburg and Dale, Ind.

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For FORD One Ton Trucks

Since the earliest years of the truck industry Wood-Detroit Hydraulic Hoists and Steel Bodies have been the standard dumping equipment—the choice of over 90% of the truck builders.

There has lately grown up a further demand from dump truck users—a call for a light, low-priced, yet sturdy dump body suitable for use on Ford and other low-priced, speedy trucks.

This need is best met by the Wood *Self-Dumper.* Made entirely of steel—operated by gravity—requiring no hoist—quick acting—serviceable—and its cost is surprisingly low.

The dual-pivot hinge prevents the smashing, racking action that has heretofore made gravity-operated bodies impractical.

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Complete Ready to Install

$140.

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7924 Riopelle Street Detroit, Mich.

Sales and Service in Principal Cities

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CHIMNEYS, CONCRETE
Heine Chimney Co., Chicago, Ill.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, RADIAL BRICK
American Chimney Corp., New York
Custodis Chimney Const. Co., Alphons, New York.
Heine Chimney Co., Chicago, Ill.
Heinicke, Inc., H. R., Indianapolis, Ind.
Kellogg & Co., M. W., New York.
Rust Engineering Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS
*Wallace & Tiernan Co., Inc., Newark, N. J.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Akron Barrow Co., Cleveland, Ohio
Insley Mfg. Co. Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

CLIPS, WIRE ROPE
American Hoist & Derrick Co., St. Paul, Minn.
Marion Malleable Iron Works, Marion, Ind.
Mockbee & Co., C. M., Cincinnati, O.
Roebling Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

COAL AND ORE CONVEYING MACHINERY
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
Barber-Greene Co., Aurora, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Brown Hoisting Mchy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Hunt Co., Inc., C. W., West New Brighton, N. Y
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

COCKS, CURB AND CORPORATION
*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Mueller Mfg. Co., H., Decatur, Ill.

COLUMN CLAMPS
*Sterling Wheelbarrow Co., Milwaukee, Wis.
Hydraulic Steelcraft Co., Cleveland, O.
Insley Mfg. Co., Indianapolis, Ind.
Universal Form Clamp Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER
*Truscon Laboratories, Detroit, Mich.
Anti-Hydro Waterproofing Co., Newark, N. J.
General Chemical Co., New York.
General Fireproofing Co., Youngstown, Ohio.
Granitex Corp., New York.
Horn Co., A. C., Long Island City, N. Y.
Master Builders Co., Cleveland, O.
Sonneborn Sons, Inc., L., N. Y. "Lapidolith"

CONCRETE MIXERS
*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Jaeger Machine Co., Columbus, O.
*Atlas Eng. Co., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Austin Machinery Corp'n, Toledo, O.
Badger Concrete Mixer Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Iowa.
Contractors' Equipment Co., Keokuk, Ia.
Foote Concrete Mchy. Co., Chicago, Ill.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Lakewood Engineering Co., Cleveland, O.
Lansing Co., Lansing, Mich.
Marsh-Capron Co., Chicago, Ill.
Milwaukee Concrete Mixer Co., Milwaukee, Wis.
Oshkosh Mfg. Co., Oshkosh, Wis.
Republic Iron Works, Tecumseh, Mich.
Schramm, Inc., West Chester, Pa.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.
Truckmixer Co., Milwaukee, Wis.
Worthington Pump & Mach'y Corp., New York

CONCRETE PILING. (See Piling, Concrete)

CONCRETE REINFORCEMENT
*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., New York.
Consolidated Expanded Metal Co., Braddock, Pa
Corrugated Bar Co., Inc., Buffalo, N. Y.
Electric Welding Co., Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Ryerson & Son., J. T., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.
Youngstown Pressed Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown, O.

CONCRETE ROAD FINISHERS
*Dunn Road Mach. Co., Conneaut, Ohio.
Heltzel Steel Form & Iron Co., Warren, O.
Lakewood Eng. Co., Cleveland, Ohio

CONCRETE TOOLS
*Dallett Co., Thos. H., Philadelphia, Pa.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mach'y Corp., New York.

CONDUIT RODS
Bissell Co., F., Toledo, Ohio.
Turbine Sewer Machine Co., Milwaukee, Wis.
Waldo Bros. & Bond Co., Boston, Mass.

CONDUITS, INTERIOR
American Circular Loom Co., Boston, Mass.
Central Tube Co., Pittsburgh, Pa.
National Metal Molding Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

CONDUITS, UNDERGROUND
American Vitrified Products Co., Akron, Ohio.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Fibre Conduit Co., Orangeburg, N. Y.
Johns-Manville, Inc., New York.
National Fireproofing Co., New York.

CONTRACTORS' SUPPLY DEALERS
(See pages 101-116)

CONTRACTORS' USED EQUIPMENT
*Haetten Co., J. E., New York.
*Kleinhans Co., H., Pittsburgh, Pa.

CONVEYORS, BELT
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Barber-Greene Co., Aurora, Ill.
Chain Belt Co., Milwaukee, Wis.

Gifford Wood Co., Hudson, N. Y.
Goodyear Tire & Rubber Co., Akron, O.
Imperial Belting Co., Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Republic Rubber Co., Youngstown, O.
Standard Conveyor Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CONVEYORS, BUCKET

*Atlas Engineering Co., Milwaukee, Wis.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Hains Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland, O.
Caldwell & Son, H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conveyor Co., Elkhart, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Olson & Co., Sam'l, Chicago, Ill.
Republic Rubber Co., Youngstown, O.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CONVEYORS, GRAVITY

Alvey-Ferguson Co., Cincinnati, O.
Dow Co., Louisville, Ky.
Lamson Co., Syracuse, N. Y.
Mathews Gravity Carrier Co., Elwood City, Pa.
Standard Conveyor Co., No. St. Paul, Minn.

CRANES, LOCOMOTIVE

*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravena, O.
Davenport Locomotive Works, Davenport, Ia.
Erie Steam Shovel Co., Erie, Pa.
Hanna Eng. Works, Chicago, Ill.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Champaign, Ill
Marion Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Northwest Engineering Works, Chicago, Ill.
Orton & Steinbrenner Co., Chicago, Ill.
Ohio Locomotive Crane Co., Bucyrus, O.
Osgood Co., The, Marion, O.
Overland Crane Co., Hammond, Ind.
Thew Shovel Co., Lorain, O.
U. S. Crane Co., Chicago, Ill.

CRANES, OVERHEAD TRAVELING

*Pawling & Harnischfeger Co., Milwaukee, Wis.
Alliance Machine Co., Alliance, O.
Chesapeake Iron Wks., Baltimore, Md.
Champion Engineering Co., Kenton, O.
Milwaukee Electric Crane Co., Milwaukee, Wis.
Morgan Engineering Co., Alliance, O.
Northern Eng. Works, Detroit, Mich.
Shaw Crane Works, Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N.Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

CRANES, WRECKING

Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Industrial Works, Bay City, Mich.

CREOSOTED BLOCKS, TIMBER, ETC.

American Creosoting Co., New York.
American Creosote Works, Inc., N. Orleans, La.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Colonial Creosoting Co., Inc., Bogalusca, La.
Creosoted Materials Co., New Orleans, La.
Georgia Creosoting Co., Brunswick, Ga.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Granite City, Ill.
Republic Creosoting Co., Indianapolis, Ind.
Southern Paving Constr. Co., Chattanooga, Tenn.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

CREOSOTING AND CREOSOTING OILS

Am. Creosote Wks., Inc., New Orleans, La.
Barrett Co., New York.
Jennison-Wright Co., Toledo, O.
Southern Creosoting Co., Ltd., Slidell, La.
Southern Paving Const. Co., Chattanooga, Tenn.
Wyckoff Pipe & Creosoting Co., New York.

CRUSHERS, HEAVY DUTY

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buchanan Co., C. G., New York.
Traylor Eng. & Mfg. Co., Allentown, Pa.
Worthington Pump & Machy. Corp., New York.

CRUSHERS, ROCK

*Austin-Western Road Mach. Co., Chicago, Ill.
*Galion Iron Wks. & Mfg. Co., Galion, Ill.
*Good Roads Machinery Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Acme Road Machy. Co., Frankfort, N. Y.
Case Threshing Mach. Co., J. I., Racine, Wis.
Chalmers & Williams, Chicago Hts., Ill.
Kennedy-Van Saun Mfg. & Eng. Corp., New York.
Lewistown Fdry. & Mach. Co., Lewistown, Pa.
McLanahan Stone Mach. Co., Hollidaysburg, Pa.
Morgan Engineering Co., Alliance, O.
New Holland Mach. Co., New Holland, Pa.
Smith Eng. Wks., Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Universal Crusher Co., Cedar Rapids, Ia.

CULVERTS, METAL

*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Machinery Co., Kennett Square, Pa.
*Newport Culvert Co., Newport, Ky.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmingtom, Ala.
Canton Culvert & Silo Co., Canton, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Dee Co., W. E., Chicago, Ill.
Dominion Metal Products Corp., Roanoke, Va.
Florida Metal Products Co., Jacksonville, Fla.
Hardesty Mfg. Co., The R., Denver, Colo.
Klauer Mfg. Co., Dubuque, Ia.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Madison Foundry Co., Cleveland, O.
Southern Metal Culvert Co., Salisbury, N. C.
Wheeling Corrugating Co., Wheeling, W. Va.
Wood & Co., R. D., Philadelphia, Pa.

CURB BOXES

*Clark Co., H. W., Mattoon, Ill.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Foundry Mfg. Co., St. Albans, Vt.
Madison Foundry Co., Cleveland, O.
Mueller Mfg. Co., Decatur, Ill.
Thompson-Fleming Co., Inc., Buffalo, N. Y.

CURB GUARDS, STEEL

Godwin Co., W. S., Baltimore, Md.

CURB, STEEL PROTECTED

*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., New York.
National Steel Fabric Co., Pittsburgh, Pa.
Steel Protected Concrete Co., Philadelphia, Pa

CUTTERS, PIPE, HAND

Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., New Haven, Conn.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp'n., Greenfield, Mass.
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

CUTTERS, ROD AND WIRE

*Koehring Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Carpenter & Co., Geo. B., Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy. Corp., New York.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

CUTTING AND WELDING APPARATUS
Macleod Co., Cincinnati, O.
Milburn Co., Alexander, Baltimore, Md.
Prest-O-Lite Co., Inc., New York.

DERRICKS, GUY AND STIFF-LEG
American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., Ravenna, O.
Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Federal Bridge & Struc. Co., Waukesha, Wis.
Flory Mfg. Co., S., Bangor, Pa.
Horton Co., John T., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis
Lidgerwood Manufacturing Co., New York.
Lincoln Iron Works, Rutland, Vt.
National Hoisting Engine Co., Harrison, N. J
Sasgen Derrick Co., Chicago, Ill.
Smith, Whitcomb & Cook Co., Barre, Vt.
Superior Iron Works, Superior, Wis.

DERRICKS, PIPE LAYING
Austin Machinery Corp'n, Toledo, O.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

DERRICKS, REVOLVING
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.

DERRICKS, STEEL
*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

DERRICKS, STEEL PORTABLE
Austin Machinery Corp'n, Toledo, O.
Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill

DERRICKS, TRAVELING
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Nat'l Hoisting Engine Co., Harrison, N. J.
Orton & Steinbrenner Co., Chicago, Ill.

DIESEL ENGINES. (See Engines, Oil)

DISTRIBUTING PLANTS, CONCRETE
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Archer Iron Works, Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

DITCHING MACHINES (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)
*Godwin Co., W. S., Baltimore, Md.

DOORS, METAL
Central Metal Products Corp., Canton, Ohio.
Dahlstrom Metallic Door Corp., Jamestown, N. Y.
Friedrich Co., E. H., Holyoke, Mass.
Lawton-Stephens Co., Brooklyn, N. Y.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Riester & Thesmacher Co., Cleveland, Ohio.
Sykes Co., Chicago, Ill.
Thorp Fireproof Door Co., Minneapolis, Minn.

DOORS AND SHUTTERS, STEEL ROLLING
Cornell Iron Works, New York.
Kinnear Mfg. Co., Columbus, O.
Variety Mfg. Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES
Universal Drafting Machine Co., Cleveland, O

DREDGES
American Steel Dredge Co., Fort Wayne, Ind.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n., Baltimore, Md.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Osgood Co., The, Marion, O.
Stockton Iron Works, Stockton, Cal.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER
American Steel Dredge Co., Fort Wayne, Ind
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING PUMPS AND ACCESSORIES
Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR
*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE
*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.
Sullivan Mach'y Co., Chicago, Ill.

DRILLS, HAMMERS (PNEUMATIC)
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Natl. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, ROCK
*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Natl. Elec. Mfg. Co., Pittsburgh, Pa.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machinery)

DRUMS, HOLDING
Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT
Allis-Chalmers Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O

DRYERS, SAND AND GRAVEL
*Littleford Bros., Cincinnati, Ohio.

DUMP BODIES FOR MOTOR TRUCKS
*Heil Company, Milwaukee, Wis.
*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Columbia Wagon & Body Co., Columbia, Pa.
Horizontal Hydraulic Hoist Co., Detroit, Mich.
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Connesutville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.

DUMP CARTS AND WAGONS, HORSE DRAWN
*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Machinery Co., Frankfort, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Columbia Wagon & Body Co., Columbia, Pa.
Eagle Wagon Works, Auburn, N. Y.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Tiffin Wagon Co., Tiffin, Ohio.
Watson Products Corp., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING AND ROAD BINDER MATERIALS
*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., Solvay, N. Y.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
Barrett Co., New York.
Carbondale Calcium Co., Carbondale, Pa.
Dustoline for Roads Co., Summit, N. J.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE
Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC LAMPS
General Electric Co., Schenectady, N. Y
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS
*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.
Bissell Co., F., Toledo, Ohio.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Atlas Eng. Co., Milwaukee, Wis.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.
Albro-Clem Elevator Co., Philadelphia, Pa.
Amer. Elevator & Mach. Co., Louisville, Ky.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgeway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE
*Climax Engineering Co., Clinton, Ia.
*Hercules Corpn., Evansville, Ind.
*Holt Mfg. Co., Peoria, Ill.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Nelson Bros. Co., Saginaw, Mich.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York

ENGINES, OIL

DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Anderson Fdry. & Mach. Co., Anderson, Ind
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York
De La Vergne Machine Co., New York

Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hoover, Owen, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY

Bucyrus Co., South Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.

EXCAVATORS, DITCH AND TRENCH

*Keystone Driller Co., Beaver Falls, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Ball Engine Co., Erie, Pa.
Buckeye Traction Ditcher Co., Findlay, Ohio.
Bucyrus Co., South Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE

*Bay City Dredge Works, Bay City, Mich.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade Excavator Works, C. L., Iowa Falls, Iowa
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Smith Co., T. L., Milwaukee, Wis.

EXPANDED METAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel Co., Warren, O.

EXPANSION JOINT MATERIAL

*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Barrett Co., New York.
Servicised Products Co., Chicago, Ill.

EXPLOSIVES

Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del
Giant Powder Co., Cons., San Francisco, Cal
Hercules Powder Co., Wilmington, Del.

FENCING

Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Co., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

FILING EQUIPMENT, STEEL

Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL

Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER

American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS

Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS

Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col.
Interstate Machine Prod. Co., Rochester, N. Y.
Sireno Co., Stapleton, N. Y.
Union Water Meter Co., Worcester, Mass.

FIRE APPARATUS, MOTOR

*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Northern Fire Apparatus Co., Minneapolis, Minn.
Foamite-Childs Corp., Utica, N. Y.
Piraeh & Sons Co., Peter, Kenosha, Wis.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Co., St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL

American-La France Fire Eng. Co., Elmira, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIREPROOF BUILDING MATERIAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Delaware Clay Products Co., Pittsburgh, Pa.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

FIRST AID EQUIPMENT
American-La France Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS
*Central Foundry Co., New York.
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
United Lead Company, New York.

FLOORING, COMPOSITION
*Barber Asphalt Co., Philadelphia, Pa.
Am. Mason Safety Tread Co., Lowell, Mass.
Barrett Co., New York.
Johns-Manville Co., H. W., New York.
Marine Decking & Supply Co., Phila., Pa.
Muller, Franklyn R., & Co., Waukegan, Ill.

FLOORS, WOOD BLOCK
Barrett Co., New York.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Servicised Products Co., Chicago, Ill.
Son. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS
Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Hauck Mfg. Co., Brooklyn, N. Y.

FORM CLAMPS
Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Form Clamp Co., Chicago, Ill.

FORMS, CONCRETE
*Connery & Co., Philadelphia, Pa.
*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Concrete Form Co., Inc., Syracuse, N. Y.
Hetzel Steel Form & Iron Co., The, Warren, O.
Hydraulic Steelcraft Co., Cleveland, O.
Lakewood Eng. Co., Cleveland, Ohio.
Metal Forms Corp., Milwaukee, Wis.

FOUNTAINS, DRINKING
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. (See Cans)

GARBAGE DISPOSAL
Balmer Corp., New York.
Bartlett, C. O. & Snow Co., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND WAGONS
*Austin Western Road Mchy. Co., Chicago, Ill.
*Federal Motor Truck Co., Detroit, Mich.
*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Autocar Co., Ardmore, Pa.
Four Wheel Drive Auto Co., Clintonville, Wis
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Service Motor Truck Co., Wabash, Ind.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.
White Co., Cleveland, O.

GAS ENGINES. (See Engines, Gas and Gasoline.)

GAS METERS
*Pittsburgh Meter Co., East Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Builders Iron Foundry, Providence, R. I.
Cleveland Gas Meter Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.

GAS PRODUCERS
Camden Iron Works, Camden, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, Ohio.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Byers Machine Co., Ravenna, Ohio.
Chicago Bridge & Iron Works, Chicago, Ill.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
Hardesty Mfg. Co., R., Denver, Col.

GAUGES, RECORDING, PRESSURE, STEAM
Ashcroft Mfg. Co., Bridgeport, Conn.
Bristol Co., Waterbury, Conn.
Crosby Steam Gauge & Valve Co., Boston, Mass
Marsh & Co., Jas. P., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
U. S. Gauge Co., New York

GAUGES, WATER
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
*Clark Co., H. W., Mattoon, Ill.
Builders Iron Foundry, Providence, R. I.
Simplex Valve & Meter Co., Philadelphia, Pa.

GLASS, FIREPROOF. (See Wire Glass.)

GRADERS, ROAD (See "Road Graders")

GRADER BLADES
*Adams & Co., J. D., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, Ohio.

GRAND STANDS, PORTABLE
Leavitt Mfg. Co., Urbana, Ill.
Wayne Iron Wks., Philadelphia, Pa.

GRINDERS AND SAND RAMMERS
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Ingersoll-Rand Co., New York, N. Y.

GYPSUM PRODUCTS
U. S. Gypsum Co., Chicago, Ill.

HAMMER DRILLS
(See Drills, Hammer.)

Not the Grand Canyon But a P&H Excavated Ditch

Through shale and rock, the P & H No. 152 Trench Excavator dug this clean deep trench. No comment is needed to show why P & H machine digging of this kind can be done more quickly and at a lower cost than any other method. The removal of the spoil alone in the case of deep ditches is a problem not easily solved.

From Hard Earth to Swamp

The same P & H after completing the cut through the shale and rock was later put to work cutting a ditch through a swamp where the mud and silt ran like water. A whole herd of mules sunk out of sight at the spot where the P & H Trench Excavator is shown working in the lower illustration. After draining, the trench was successfully dug by the P & H through the mud and the underlying strata of oil sand. The low bearing pressure of the P & H was important here.

Two Types of Trench Excavators

P & H Wheel Type Trenchers are designed for use in digging trenches up to 7½ feet in depth. The Ladder Type as shown on this page is designed for ditches of greater depths (15 feet maximum for standard machines).

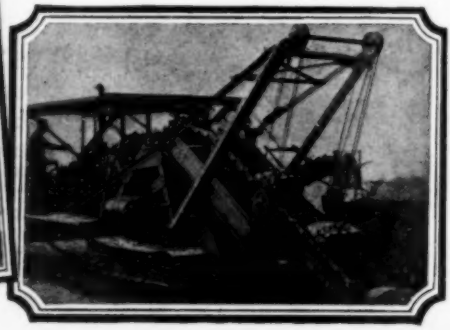
Excavating Machinery Division

PAWLING & HARNISCHFEGER CO.

Established in 1884

3819 National Ave., Milwaukee, Wis.

Offices and Agents in Principal Cities



Bulletin 16-X describes both types in detail and will be forwarded on request.

PAWLING & HARNISCHFEGER CO. P AND H TRADE MARKS OF P&H EQUIPMENT

TRENCH EXCAVATORS

HAMMERS, STEAM, PILE. (See Pile Hammers, Steam)

HEAT INSULATING MATERIAL

*Carey Co., Philip, Cincinnati, Ohio.
Johns-Manville, Inc., New York.

HEATERS AND DISTRIBUTORS, TAR AND ASPHALT HEATING KETTLES

*Kinney Mfg. Co., Boston, Mass.

HEATING KETTLES. (See Kettles)

HOISTS, BELT-DRIVEN

*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Weller Mfg. Co., Chicago, Ill.

HOISTS, CONCRETE, TOWER

*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Mead-Morrison Mfg. Co., E. Boston, Mass.

HOISTS, ELECTRIC

*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Treadwell Eng. Co., Easton, Pa.

HOISTS, GASOLINE

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Construction Machy. Co., Waterloo, Iowa.
Domestic Engine & Pump Co., Shippensburg, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Lansing Co., Lansing, Mich.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Monighan Machine Co., Chicago, Ill.
Mundy Hoisting Engine Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Novo Engine Co., Lansing, Mich.
O. K. Clutch & Mach. Co., Columbia, Pa.
Orr & Sembower, Reading, Pa.
Schramm, Inc., West Chester, Pa.
Street Bros. Mach. Wks., Chattanooga, Tenn.

HOISTS, PNEUMATIC

*Denver Rock Drill Mfg. Co., Denver, Colo.
Chicago Pneumatic Tool Co., New York.
Detroit Hoist & Machine Co., Detroit, Mich.
Hanna Eng. Works, Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Northern Engineering Works, Detroit, Mich.
Sullivan Mach'y Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

HOISTS, STEAM

*Denver Rock Drill Mfg. Co., Denver, Colo.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Flory Mfg. Co., S., Bangor, Pa.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.
National Hoisting Engine Co., Harrison, N. J.
Orr & Sembower, Reading, Pa.
Treadwell Eng. Co., Easton, Pa.

HOISTS FOR MOTOR TRUCKS

*Heil Co., The Milwaukee, Wis.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
Horizontal Hydr. Hoist Co., Detroit, Mich.
Perfection Hoist & Engine Co., Two Rivers, Wis.
Van Dorn Iron Wks., Cleveland, O.

HOLLOW TILE

Bannon Pipe Co., P., Louisville, Ky.
Dee Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
National Fireproofing Co., Pittsburgh, Pa.

HOPPERS, CONCRETE

*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Weller Mfg. Co., Chicago, Ill.

HOSE, AIR

Cincinnati Rubber Mfg. Co., Cincinnati, O.
Goodyear Tire & Rubber Co., Akron, O.
Ingersoll-Rand Co., New York.
Penna Flexible Metallic Tubing Co., Phila., Pa.
Republic Rubber Co., Youngstown, O.
U. S. Rubber Co., New York

HOSE, FIRE

*Goodrich Rubber Co., B. F., Akron, O.
Bi-Lateral Fire Hose Co., Chicago, Ill.
Fabric Fire Hose Co., New York.
Goodyear Tire & Rubber Co., Akron, Ohio.
U. S. Rubber Co., New York.

HOUSE NUMBERS

Hamilton Metal Prod. Co., Hamilton, O.
Niagara Metal Stamping Corp., Niagara Falls, N. Y.

HOUSES, PORTABLE. (See Buildings, Portable)

HYDRANTS, FIRE

*Ludlow Valve Mfg. Co., Troy, N. Y.
*Rensselaer Valve Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Norwood Engineering Co., Florence, Mass.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

HYDRAULIC RAMS

Deming Co., Salem, O.
Rice Hydraulic Engine Co., New York
Seattle Machine Works, Seattle, Wash.

ICE-MAKING MACHINERY

Brunswick-Kroeschell Co., New Brunswick, N. J.
Carbondale Machine Co., Carbondale, Pa.
Frick Co., Inc., Waynesboro, Pa.
Triumph Ice Machine Co., Cincinnati, O.
Vilter Mfg. Co., Milwaukee, Wis.
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Whether it is the construction of a reinforced concrete warehouse as the Belknap Building shown below; big industrials as the Fisher Body plant; the world's largest office building, as the General Motors in Detroit; big dams as the Muscle Shoals, one of the projects where the largest mixers any one ever attempted (Smith 112-S, capacity 4 cu. yards per batch) were used; important causeways as at Galveston; the famous 6000-foot Hill-to-Hill Bridge at Bethlehem; reservoirs, large and small—you will find Smith Tilting Type Construction Mixers were used.

For mixing the concrete for the Belknap Building, Louisville, a Smith 21-S Titling Mixer driven by electric motor was used. A batch feed hopper took the aggregate from side dump cars.

Dependability, quick discharge, long life are but three of the inherent qualities of Smith Mixers well known to experienced construction engineers and contractors.

The T. L. SMITH CO.
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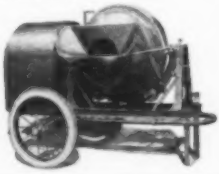
The newest, smallest, but most accurate model of Smith Mixers, especially designed to meet the growing demand for a small tilting mixer, the Smith Half Bag Tilter already has justified its appearance by the large number of orders received. It has the same speedy discharge, and fast, continuous production that characterizes the large Smith Tilters. It has a mixed batch capacity of 4 cubic feet, a full half bag (1-3-6 mix) with materials containing the usual 40% voids. Its parts are all made to the closest micrometer tolerances and each machine is subjected to a most rigid inspection before leaving the factory. Made in two styles—with either two or four wheels—the Smith Half Bag Tilter offers the maximum in portability—is easily towed from job to job. Send for descriptive circular.



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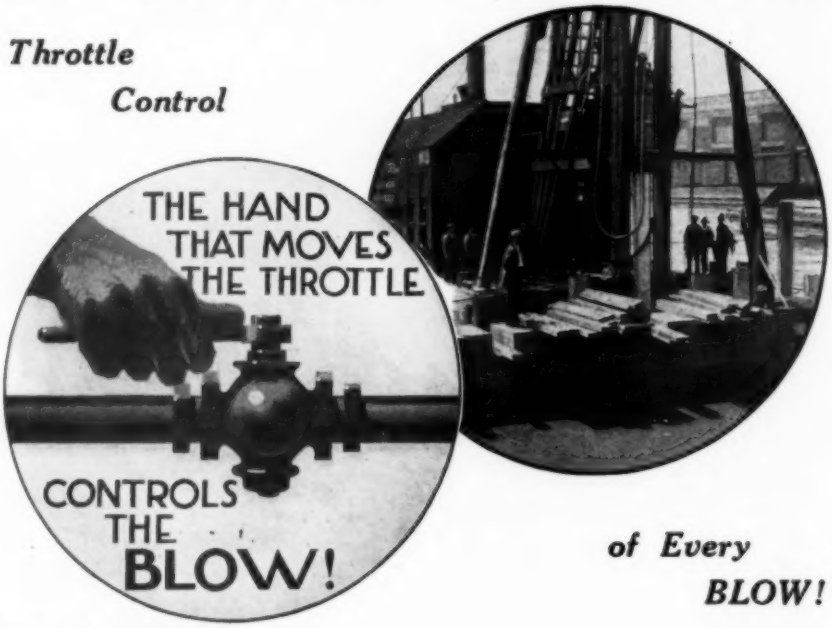
For Concrete Pile Driving

Throttle Control



of Every BLOW!

You get it with

McKiernan-Terry Hammers

9-B and 11-B Double Acting

At last it is possible to use heavy pile hammers to drive concrete piles—or heavy timber piles—when prevailing conditions seem to indicate loading and jetting as the only method possible.

The throttle control of the blows of McKiernan-Terry 9-B and 11-B concrete Pile driving Hammers permits exact regulation of the velocity, energy and frequency of the blows!

The fact is, the throttle control made possible by these Hammers permits exact regulation of the blow for any size and type of concrete pile and soil resistance.

A touch of the operator's hand on the throttle, and the steam accelerated ram of these big hammers can be made to merely tap-tap on the pile head.

—or to deliver from 120 to 140 blows a minute using the entire force of the 1250 lb. and 3625 lb. rams.

Think this over. Your experience will tell you that throttle control of velocity, energy and frequency of ram blows is essential to meet varying conditions of driving concrete piles and heavy timber piling.

In McKiernan-Terry Double Acting pile hammers you get throttle control of every blow. Write for Bulletin 31 fully descriptive of these hammers.

McKIERNAN-TERRY DRILL COMPANY

Rock Drills **Pile Hammers** **Lifting Jacks** **Mining and Quarrying Machinery**

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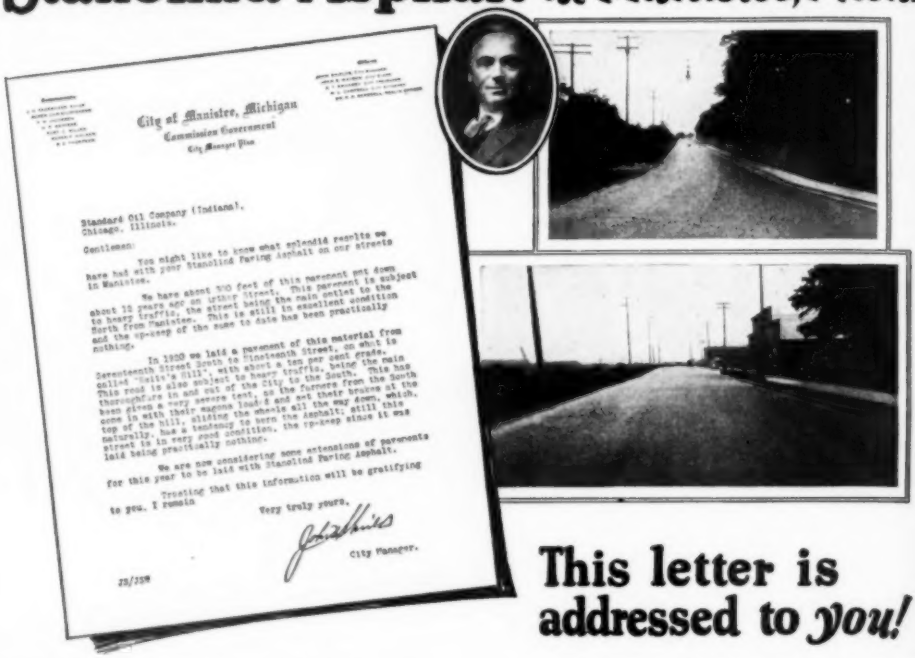
Stanolind Asphalt *at Manistee, Mich.*



City of Manistee, Michigan
Commission Government
City Manager Plan

Standard Oil Company (Indiana),
Chicago, Illinois.

Gentlemen:

You might like to know what splendid results we have had with your Stanolind Paving Asphalt on our streets in Manistee.

We have about 900 feet of this pavement put down about 12 years ago on Arthur Street. This pavement is subject to heavy traffic, the street being the main outlet to the North from Manistee. This is still in excellent condition and the up-keep of the same to date has been practically nothing.

In 1920 we laid a pavement of this material from Seventeenth Street South to Nineteenth Street, on what is called "Hatt's Hill", with about a ten per cent grade. This road is also subject to heavy traffic, being the main thoroughfare in and out of the City to the South. This has been given a very severe test, as the farmers from the South come in with their wagons loaded and get their brakes set, which, naturally, has a tendency to burn the asphalt; still this street is in very good condition, the up-keep since it was laid being practically nothing.

We are now considering some extensions of pavements for this year to be laid with Stanolind Paving Asphalt.

Trusting that this information will be gratifying to you, I remain

Very truly yours,

City Manager.

JS/JSH

This letter is addressed to *you!*

THE above letter, written by Mr. John Shields, City Manager of Manistee, Michigan, might well have been addressed to you as being responsible for the construction and maintenance of the roads and streets in your community. Without a doubt you would appreciate the unbiased opinion of one who has had long experience with Stanolind Paving Asphalt and therefore knows what he is talking about.

Mr. Shields stresses strongly the low up-keep of the two pavements under the severe traffic conditions and sends us the photographs showing their present excellent condition.

To you, however, the next to the last paragraph is most important. For, regardless of the other good things Mr. Shields says about Stanolind Asphalt, the fact that he plans to use it again is certain proof of its worth.

Mr. Shields' experience with Stanolind Paving Asphalt is by no means exceptional. Letters, records and photographs are constantly coming to our attention, all giving proof to our assertion that Stanolind Paving Asphalt laid at a low initial cost, noted for its freedom from repairs and its long life, is the ideal road-building material.

We have recently issued a booklet which tells the latest methods of constructing and maintaining bituminous pavements. It will be sent to you free, upon request.

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Warren Tool & Forge Co., Warren, O.
Warwood Tool Co., Wheeling, W. Va.
Wyoming Shovel Wks., Wyoming, Pa.

PILE DRIVERS
*McKiernan-Terry Drill Co., New York.
Browning Co., Cleveland, O.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
McMyler Interstate Co., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
*McKiernan-Terry Drill Co., New York.
Clyde Iron Works Sales Co., Duluth, Minn.
Industrial Works, Bay City, Mich.
National Hoisting Eng. Co., Harrison, N. J.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Chicago, Ill.

PILING, CONCRETE
MacArthur Concrete Pile & Foundation Co., N.Y
Raymond Concrete Pile Co., New York.

PILING, INTERLOCKING STEEL
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PIPE, CAST IRON
*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdy. Co., Burlington, N.J.
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Emaus, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
National Cast Iron Pipe Co., Birmingham, Ala.
Warren Fdry. & Machine Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE, CULVERT (See Culverts)

PIPE, LEAD
United Lead Company, New York

PIPE, REINFORCED CONCRETE
Concrete Products Co., Pittsburgh, Pa.
Core Joint Concrete Pipe Co., Baltimore, Md.

Independent Concrete Pipe Co., Indianapolis Ind.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Concrete Products Corp'n, Chicago, Ill

PIPE, RIVETED STEEL

*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros. Cincinnati, Ohio.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Canton Culvert & Silo Co., Canton, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Col.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tippet & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

PIPE, SPIRAL RIVETED

Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.

PIPE STEEL

East Jersey Pipe Co., New York.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Steel & Tube Co. of Am., Chicago, Ill.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD

American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON

Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE BENDING MACHINES

Amer. Pipe Bending Mach. Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

PIPE COVERING

AIRCELL

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Nat'l Asbestos Co., Jersey City, N. J.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mt. Co., Chicago, Ill.
Watson Co., H. F., Erie, Pa.

85 PER CENT MAGNESIA

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.

WOOD

Continental Pipe Mfg. Co., Seattle, Wn.
Redwood Mfrs. Co., San Francisco, Cal.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE CUTTERS. (See Cutters, Pipe, Hand.)

PIPE FITTINGS

*Central Foundry Co., New York.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American C. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry, Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Bridgeport, Conn.
Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY

Mueller Mfg. Co., H., Decatur, Ill.
Taylor Portable Steel Derrick Co., Chicago, Ill.

PIPE JOINT COMPOUND. (Sewer)

*Carey Co., Philip, Cincinnati, Ohio.
*Waring-Underwood Co., Philadelphia, Pa.
G. K. Sales Co., Macungie, Pa.
Leadite Company, Inc., Philadelphia, Pa.
Pacific Flush Tank Co., Chicago, Ill.
Ruberoid Co., New York.

PIPE JOINT MATERIAL. (Cast Iron)

Lead-Hydro-Tite Co., Boston, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Co., New York.

PLAYGROUND APPARATUS

American Playground Device Co., Anderson, Ind
Eureka Mfg. Co., Sandusky, O.
Everwear Mfg. Co., Springfield, O.
George, Howard, Philadelphia, Pa.
Hill Standard Co., Anderson, Ind.
Medart Mfg. Co., Fred., St. Louis, Mo.
Spalding & Bros., A. G., Chicopee, Mass.

PLOWS, CONTRACTORS

*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.
*Holt Mfg. Co., Peoria, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Steel Scraper Co., Sidney, O.
Avery Co., Peoria, Ill.
Deere & Co., Moline, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
International Harvester Co., Chicago, Ill.
Moline Plow Co., Rock Island, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Sidney Steel Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.
Wiard Plow Co., Batavia, N. Y.

PLUMBING SUPPLIES

Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Glauber Brass Mfg. Co., Cleveland, O.
Mott Iron Wks., J. L., New York
Mueller Mfg. Co., H., Decatur, Ill.
Randle-Spence Mfg. Co., Milwaukee, Wis.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, STEEL STRUCTURAL

Blaw-Knox Co., Pittsburgh, Pa.
Electric Railway Equipment Co., Cincinnati, O.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa

PORTABLE BUILDINGS

*Littleford Bros., Cincinnati, Ohio.
*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Milwaukee Corrugating Co., Milwaukee, Wis.
Pruden Co., C. D., Baltimore, Md.

PORTABLE STEEL DERRICKS. (See Derricks, Steel Portable.)

PORTLAND CEMENT. (See Cement.)

POWDER. (See Explosives.)

PUMPS, AIR LIFT

Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

PUMPS, BOILER FEED

Advance Pump & Compr. Co., Battle Creek, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.

Gould Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Northern Fire Apparatus Co., Minneapolis, Minn.
Scranton Pump Co., Scranton, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CENTRIFUGAL

*Keystone Driller Co., Beaver Falls, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Domestic Engine & Pump Co., Shippensburg, Pa.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gould Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Manistee Iron Wks., Manistee, Mich.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Schramm, Inc., West Chester, Pa.
United Iron Works, Kansas City, Mo.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mchy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
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Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Cameron Steam Pump Works, A. S., New York.
Carter Co., Ralph B., New York.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Dayton-Dowd Co., Quincy, Ill.
Deming Co., Salem, Ohio.
Domestic Engine & Pump Co., Shippensburg, Pa.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gould Mfg. Co., Seneca Falls, N. Y.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., Ashland, O.
Northern Fire App. Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
Schramm, Inc., West Chester, Pa.
Smith Co., T. L., Milwaukee, Wis.
Standard Scale & Supply Co., Pittsburgh, Pa.
Van Nouhuys Machine Wks., Albany, N. Y.
Waldo Bros. & Bond Co., Boston, Mass.

PUMPS, DEEP WELL

*Aldrich Pump Co., Allentown, Pa.
*Clark Co., H. W., Mattoon, Ill.
*Keystone Driller Co., Beaver Falls, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Cook, Inc., A. D., Lawrenceburg, Ind.
Deming Co., Salem, O.
Domestic Engine & Pump Co., Shippensburg, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Gould Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
McDonald Mfg. Co., A. Y., Dubuque, Ia.
Midwest Engine Co., Indianapolis, Ind.
Myers & Bro. Co., F. E., Ashland, O.
United Iron Works, Kansas City, Mo.
Weber Subterranean Pump Co., New York.

PUMPS, DREDGING

*Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Wks., A. S., New York.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Rumsey Pump Co., Ltd., Seneca Falls, N. Y.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Mchy. Corp., New York.

PUMPS, GASOLINE AND OIL

*Kinney Mfg. Co., Boston, Mass.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Northern Fire App. Co., Minneapolis, Minn.
Wayne Tank & Pump Co., Fort Wayne, Ind.
Worthington Pump & Mach. Corp., New York.

PUMPS, POWER

*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
Alamo Iron Works, San Antonio, Tex.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., Shippensburg, Pa.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Gould Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lawrence Machine Co., Lawrence, Mass.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Myers & Bro. Co., F. E., Ashland, O.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Fire Aparatus Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Machy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

RAILS AND RAIL JOINTS

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Cambria Steel Co., Philadelphia, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Easton Car & Constn. Co., New York.
Sweet's Steel Co., Williamsport, Pa.

RAILROAD DITCHERS (See Excavators, Ditch and Trench.)

RECORDERS, WATER STAGE

Builders Iron Fdry., Providence, R. I.
Gurley, W. & L. E., Troy, N. Y.

REFRIGERATING MACHINERY. (See Ice Making Machinery.)

REINFORCING CONCRETE. (See Concrete Reinforcements.)

RIVETERS, PNEUMATIC

Alliance Machine Co., Alliance, O.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Watson-Stillman Co., New York.

RIVET SETS

Cleveland Pneumatic Tool Co., Cleveland, O.
Dunbar Drop Forge Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

ROAD GRADERS

*Adams & Co., J. D., Indianapolis, Ind.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.

*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Monroe & Sons, N. S., Arthur, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Smith & Sons Mfg. Co., Kansas City, Mo.
Stockland Road Machine Co., Minneapolis, Minn.

ROAD OILS. **(See Oils, Road.)**

ROAD OILERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Connery & Co., Philadelphia, Pa.
*Good Roads Mach. Co., Kennett Square, Pa.
*International Motor Co., New York.
*Kinney Mfg. Co., Boston, Mass.
*Littleford Bros., Cincinnati, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
White Co., Cleveland, O.

ROAD AND PAVING ROLLERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co., Springfield, O.
*Erie Machine Shops, Erie, Pa.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach. Co., Kennett Square, Pa.
Avery Co., Peoria, Ill.
Case Threshing Machine Co., J. I., Racine, Wis
Huber Mfg. Co., Marion, O.

ROAD AND PAVING MACHINERY

*Adams & Co., J. D., Indianapolis, Ind.
*Atlas Engineering Co., Milwaukee, Wis.
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Barber Asphalt Co., Philadelphia, Pa.
*Buffalo Springfield Roller Co, Springfield, O.
*Connery & Co., Inc., Philadelphia, Pa.
*Erie Machine Shops, Erie, Pa.
*Equitable Asph. Maint. Co., Kansas City, Mo.
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*Good Roads Mach. Co., Kennett Square, Pa.
* Haiss Mfg. Co., Geo., New York.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*Monroe & Sons, N. S., Arthur, Ill.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Mchy. Co., Kingston, N. Y.
Acme Road Mach. Co., Frankfort, N. Y.
Aultman & Taylor Mach. Co., Mansfield, Ohio.
Austin Machinery Corp'n, Toledo, O.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I. Racine, Wis.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Mach. Co., Lima, O.
Edwards Mfg. Co., C. D., Albert Lea, Minn.
Glide Road Mach'y Co., Minneapolis, Minn.
Honhorst Co., Jos., Cincinnati, O.
Lakewood Engineering Co., Cleveland, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Smith Co., T. L., Milwaukee, Wis.
Smith & Sons Mfg. Co., Kansas City, Mo.
Stockland Road Mach. Co., Minneapolis, Minn.
United Iron Works, Kansas City, Mo.

ROCK CRUSHERS AND PULVERIZERS **(See "Crushers")**

ROCK DRILLS. **(See Drills, Rock)**

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*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
American Cement Tile Mfg. Co., Pittsburgh, Pa.
Atlantic Refining & Asphalt Corp., Phila., Pa.
Barrett Co., New York.
Beaver Board Cos., Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
Certain-teed Products Corp., St. Louis, Mo.
Chatfield Mfg. Co., Cincinnati, Ohio.
Edwards Mfg. Co., Cincinnati, O.
Flintkote Co., Boston, Mass.
Johns-Manville, Inc., New York.
Keystone Roofing Mfg. Co., York, Pa.
Lehon Co., The, Chicago, Ill.
Lewis Mfg. Co., F. J., Chicago, Ill.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.
Sall Mountain Co., Chicago, Ill.
Sifo Products Co., St. Paul, Minn.
Sonneborn & Sons, Inc., L., New York
United States Gypsum Co., Chicago, Ill.
Western Elaterite Roofing Co., Denver, Colo.

ROOFING, METAL

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Edwards Mfg. Co., Cincinnati, O.
Klauer Mfg. Co., Dubuque, Ia.
Milwaukee Corrugating Co., Milwaukee, Wis.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J
United Alloy Steel Corpn., Canton, O
Youngstown Sheet & Tube Co., Youngstown, O.

ROOFING KETTLES. **(See Kettles)**

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American Mfg. Co., Brooklyn, New York.
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Hooven & Allison Co., Xenia, O.
Kelly Co., R. A., Xenia, O.
New Bedford Cordage Co., New Bedford, Mass
Peoria Cordage Co., Peoria, Ill.
Plymouth Cordage Co., N. Plymouth, Mass.
Wall Rope Wks., New York.
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Whitlock Cordage Co., New York.

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Roebling's Sons Co., J. A., Trenton, N. J.
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*Buffalo Springfield Roller Co., Springfield, O.
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*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
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Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.
Huber Mfg. Co., Marion, O.
Lyle Cul. & Rd. Equip. Co., Minneapolis, Minn.
Stockland Road Mach. Co., Minneapolis, Minn.

SCARIFIERS, TEETH FOR

Shunk Mfg. Co., Bucyrus, Ohio.

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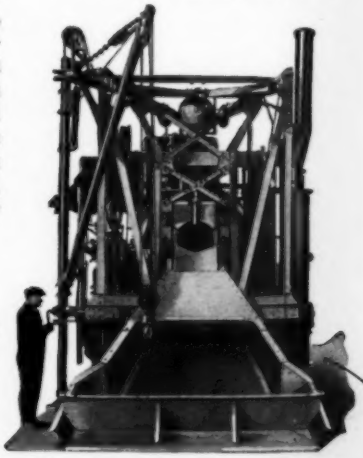

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*Littleford Bros., Cincinnati, O.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., Cleveland, O.
Case Threshing Machine Co., J. I., Racine, Wis
Chain Belt Co., Milwaukee, Wis.
Galion Iron Wks. & Mfg. Co., Galion, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Newaygo Eng. Co., Newaygo, Mich.
New Jersey Wire Cloth Co., Trenton, N. J.
Sackett Screen & Chute Co., H. B., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.

SCREENS, SEWAGE

Chain Belt Co., Milwaukee, Wis.
Link-Belt Co., Chicago, Ill.
Sanitation Corp'n, New York.

SCREWS

American Screw Co., Providence, R. I.
Clark Bros. Bolt Co., Milldale, Conn.
St. Louis Screw Co., St. Louis, Mo.

SEWAGE DISPOSAL APPARATUS

Direct Oxidation Disposal Corp., Phila., Pa.
Dorr Co., New York
Pacific Flush Tank Co., Chicago, Ill.
Sanitation Corp'n, New York.

SEWAGE PUMPS (See "Pumps, Centrifugal")

SEWAGE EJECTORS

Pacific Flush Tank Co., Chicago, Ill.
Sanitation Corp'n, New York.
Yeomans Bros. Co., Chicago, Ill.

SEWER BLOCKS, SEGMENT

American Vit. Products Co., Akron, O.
Cannelton Sewer Pipe Co., Cannelton, Ind.
Denver Sewer Pipe & Clay Co., Denver, Col.
Evens & Howard Fire Brick Co., St. Louis, Mo.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo
Laclede Christy Clay Products Co., St. Louis, Mo.
Macomb Sewer Pipe Wks., Macomb, Ill.
Pacific Clay Products Co., Los Angeles, Cal.
Red Wing Sewer Pipe Co., Red Wing, Minn.
Robinson Clay Product Co., Akron, O.
Standard Fire Brick & Sewer Pipe Co., Pueblo, Col.

SEWER CLEANING APPARATUS

Champion Corporation, Hammond, Ind.
Self Propelling Nozzle Co., New York.
Thompson Sewer Machine Co., Buffalo, N. Y.
Turbine Sewer Machine Co., Milwaukee, Wis.

SEWER PIPE AND DRAIN TILE

American Vit. Products Co., Akron, O.
Blackmer & Post Pipe Co., St. Louis, Mo.
Dee Co., Wm. E., Chicago, Ill.
Delaware Clay Products Co., Pittsburgh, Pa.
Denver Sewer Pipe & Clay Co., Denver, Col.
National Fireproofing Co., Pittsburgh, Pa.
Ohio Vitrified Pipe Co., Uhrichsville, O.
Robinson Clay Product Co., Akron, O.

SEWER RODS

Bissell Co., F., Toledo, O.
Champion Corporation, Hammond, Ind.
Turbine Sewer Machine Co., Milwaukee, Wis.

SHINGLES, METAL

Berger Mfg. Co., Canton, Ohio.
Canton Art Metal Co., Canton, Ohio.
Chattanooga Rfg. & Fdry Co., Chattanooga, Tenn.
Edwards Mfg. Co., Cincinnati, Ohio.
Eller Mfg. Co., Canton, Ohio.
Milwaukee Corrugating Co., Milwaukee, Wis.
Nat'l Sheet Metal Roofing Co., Jersey City, N. J.
Newport Rolling Mill Co., Newport, Ky.
Penn Metal Co., Boston, Mass.
Klauer Mfg. Co., Dubuque, Ia.
Tiffin Art Metal Co., Tiffin, Ohio.
Wheeling Metal Mfg. Co., Wheeling, W. Va.

SHOVELS, ELECTRIC

Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, GASOLINE

*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Thew Shovel Co., Lorain, O.

SHOVELS, HAND

American Shovel & Stamping Co., Lorain, O.
Ames Shovel & Tool Co., Boston, Mass.
Beall Bros. Co., Alton, Ill.
Conneaut Shovel Co., Conneaut, O.
Hubbard & Co., Pittsburgh, Pa.
Indiana Shovel Co., New Castle, Ind.
Jackson Shovel Co., Montpelier, Ind.
Pittsburgh Shovel Co., Pittsburgh, Pa.
Russell Shovel Co., Aliquippa, Pa.
Stevens-Webb Co., Inc., Altoona, Pa.
Union Furnace Mfg. Co., Altoona, Pa.
Wood Shovel & Tool Co., Piqua, Ohio.
Wyoming Shovel Works, Wyoming, Pa.

SHOVELS, STEAM

*Austin Machinery Corp'n, Toledo, O.
*Fairbanks Steam Shovel Co., Marion, O.
*Keystone Driller Co., Beaver Falls, Pa.
American Steel Dredge Co., Fort Wayne, Ind
Bellwood Steam Shovel Co., Bellwood, Pa.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, Ohio.
Fairbanks Steam Shovel Co., Marion, O.
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.
Smith Co., T. L., Milwaukee, Wis.
Thew Shovel Co., Lorain, O.

SIGNS, STREET AND ROAD

Baltimore Enamel & Novelty Co., Baltimore, Md.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Lyle-Signs, Minneapolis, Minn.
Municipal Products & Elec. Co., Buffalo, N. Y.
Municipal Street Sign Co., New York.
Nelke Sign Co., J. L., New York.
Union Iron Products Co., East Chicago, Ind.
Western Display & Mfg. Co., St. Paul, Minn.

SIGNS, TRAFFIC

Automatic Signal & Sign Co., Canton, O.
Best Traffic Light Co., E. Peoria, Ill.
Elkhart Fdry. & Mach. Co., Elkhart, Ind.
Essco Mfg. Co., Peoria, Ill.
Federal Signal Co., Albany, N. Y.
Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
Little Giant Co., Mankato, Minn.
Lyle-Signs, Minneapolis, Minn.

Ohio Traffic Devices Co., Columbus, O.
Safety Traffic Lt. Co., Milwaukee, Wis.
Thomson Bros., Chicago, Ill.
Traffic Sign & Signal Co., Gloucester, Mass.
Thompson-Fleming, Inc., Buffalo, N. Y.
Union Iron Products Co., E. Chicago, Ind.

SLATE, ROOFING

Vendor Slate Co., Inc., Easton, Pa.

SLATE, STRUCTURAL

Keenan Structural Slate Co., Bangor, Pa.
Penna. Structural Slate Co., Easton, Pa.
Phœnix Slate Co., Windgap, Pa.
Structural Slate Co., Pen Argyl, Pa.

SLEEVES, TAPPING AND VALVE

Mueller Mfg. Co., Decatur, Ill.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.

SLUICE GATES. (See Gates, Sluice.)

SMOKE STACKS. (See Stacks, Steel)

SNOW CLEANING MACHINERY

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Monarch Tractors, Inc., Watertown, Wis.
Avery Co., Peoria, Ill.
Barber-Greene Co., Aurora, Ill.
Cleveland Tractor Co., Cleveland, Ohio.
J. T. Tractor Co., Cleveland, O.
Toy Co., W. M., Sidney, Ohio.
Owensboro Ditcher & Grader Co., Owensboro, Ky.

SPRAYING MACHINERY

Bean Spray Pump Co., Lansing, Mich.
Deming Co., The, Salem, Ohio.
Field Force Pump Co., Elmira, N. Y.
Fitzhenry-Guptill Co., East Cambridge, Mass.

SPREADERS, STONE

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.

STACKS, STEEL

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn
Chicago Bridge & Iron Works, Chicago, Ill.
Honhorst Co., Jos., Cincinnati, O.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn

STEAM SHOVELS. (See Shovels, Steam)

STANDPIPES, TANKS AND TOWERS

*Connery & Co., Inc., Philadelphia, Pa.
Caldwell Co., W. E., Louisville, Ky.
Chattanooga Bir. & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Lancaster Iron Wks., Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM TURBINES

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STEEL PLATE CONSTRUCTION

*Connery & Co., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Wks., Akron, O.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corporation, E. Chicago, Ind.
Heltzel Steel Form & Iron Co., Warren, O.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
McClintic-Marshall Co., Pittsburgh, Pa.
Pennsylvania Bridge Co., Beaver Falls, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Crane Co., Toledo, O.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Jersey City, N. J.
Walsh & Weidner Boiler Co., Chattanooga, Tenn

STOKERS, MECHANICAL

Automatic Furnace Co., Dayton, Ohio.
Babcock & Wilcox Co., New York
Combustion Engine Corp., New York
Detroit Stoker Co., Detroit, Mich.
Laclede-Christy Clay Prod. Co., St. Louis, Mo.
Murphy Iron Works, Detroit, Mich.
Sanford Riley Stoker Co., Worcester, Mass.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS' CARTS

*Rochester Can Co., Rochester, N. Y.
Durlach Can & Iron Works, Brooklyn, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.

STREET FLUSHERS AND SPRINKLERS

*Austin-Western Road Machy. Co., Chicago, Ill.
*Federal Motor Truck Co., Detroit, Mich.
*General Motors Truck Co., Pontiac, Mich.
*Heil Co., The, Milwaukee, Wis.
*International Motor Co., New York.
*Municipal Supply Co., South Bend, Ind.
Autocar Co., Ardmore, Pa.
Etnyre & Co., E. D., Oregon, Ill.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
White Co., Cleveland, O.

STREET LAMP POSTS

Clow & Sons, J. B., Chicago, Ill.
Drake Mfg. Co., Friendship, N. Y.
Electric Railway Equipment Co., Cincinnati, O.
General Electric Co., Schenectady, N. Y.
King Mfg. Co., Chicago, Ill.
Massey Concrete Products Co., Chicago, Ill.
Mott Iron Wks., J. L., New York
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Elgin Sales Corp'n, New York.
Springfield Motor Sweeper Co., Springfield, O.

STRUCTURAL STEEL AND IRON. (See Bridges and Buildings)

STUMP PULLERS

Bennett & Co., H. L., Westerville, O.
Clyde Iron Works, Duluth, Minn.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Thomas Elevator Co., Chicago, Ill.

SUPERHEATERS

Babcock & Wilcox Co., New York.
Power Specialty Co., New York.
Superheater Co., New York.

SURVEYORS' INSTRUMENTS. (See Instruments.)

SWITCHBOARDS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg.Co.,E. Pittsburgh, Pa.

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES

*Pawling & Harnischfeger Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Ingersoll-Rand Co., New York

TANKS, AIR COMPRESSOR

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., New York.
Biggs Boiler Wks., Akron, O.
Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., New York.

TANKS, STEEL

*Connery & Co., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Avery Co., Peoria, Ill.
Biggs Boiler Wks., Akron, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Case Threshing Mach. Co., J. I., Racine, Wis.
Caldwell Co., W. E., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Dover Boiler Wks., New York.
Farrell Mfg. Co., Joliet, Ill.
Fouts Co., C. C., Middletown, O.
Graver Corporation, E. Chicago, Ind.
Hardesty Mfg. Co., R., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

TANKS, WOOD

Caldwell Co., W. E., Louisville, Ky.
Davis & Son, G. M., Palatka, Fla.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
National Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Manufacturers Co., San Francisco, Calif.
Stearns Lumber Co., A. T., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wendnagel & Co., Chicago, Ill.

TANK WAGONS

*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.

TAPES, STEEL AND METALLIC

*Lufkin Rule Co., Saginaw, Mich.
Dietzgen Co., Eugene, New York.
Keuffel & Esser Co., Hoboken, N. J.
Starrett, L. S., Athol, Mass.

TAPPING MACHINES

Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., E. Orange, N. J.

TAR

American Tar Products Co., Chicago, Ill.
Barrett Co., New York.

TAR KETTLES. (See Kettles)

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS

Pyle-Rogers Corp., New York.

TIRES, RUBBER. (For Motor Trucks.)

*Goodrich Rubber Co., Akron, O.
Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
Republic Rubber Co., Youngstown, O.
U. S. Tire Co., New York.

TOOL HOUSES, PORTABLE STEEL

*Littleford Bros., Cincinnati, O.

TOWERS (See Standpipe Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Lakewood Engineering Co., Cleveland, O.

TRACTORS

*Best Tractor Co., C. L., San Leandro, Cal.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Monarch Tractors, Inc., Watertown, Wis.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Avery Co., Peoria, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bates Machine & Tractor Co., Joliet, Ill.
Case Threshing Machine Co., J. I., Racine, Wis
Clark Tracktractor Co., Chicago, Ill.
Cleveland Tractor Co., Cleveland, O.
Dayton-Dowd Co., Quincy, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Hart-Parr Co., Charles City, Iowa.
Huber Mfg. Co., Marion, O.
International Harvester Co., Chicago, Ill.
J. T. Tractor Co., Cleveland, O.
Little Giant Co., Mankato, Minn.
Moline Plow Co., Rock Island, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Tioga Tractor Co., Baltimore, Md.
Twin City Co., Minneapolis, Minn.
White Company, The, Cleveland, O.

TRAFFIC PAINT

Hoosier Paint Wks., Ft. Wayne, Ind.
Sewall Paint & Glass Co., Kansas City, Mo.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

TRAFFIC SIGNS. (See "Signs, Traffic")

TRAILERS FOR TRUCKS AND TRACTORS

Arcadia Trailer Corp., Newark, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Lee Trailer & Body Co., Chicago, Ill.
Troy Wagon Works, Troy, O.
Warner Mfg. Co., Beloit, Wis.
Watson Products Corp'n., Canastota, N. Y.

TRAILERS, INDUSTRIAL

Chase Fdry. & Mfg. Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.

TRAMWAYS, AERIAL WIRE ROPE

Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.

TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TRANSITS AND LEVELS. (See Instruments.)

TRANSMISSION MACHINERY, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Dodge Mfg. Corp'n, Mishawaka, Ind.
General Electric Co., Schenectady, N. Y.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

TRASH CANS. (See Cans)

TREADS, SAFETY
American Abrasive Metals Co., New York.
American Mason Safety Tread Co., Lowell, Mass.
Concrete Steel Co., New York.
Hendrick Mfg. Co., Carbondale, Pa.
Norton Co., Worcester, Mass.

TRENCH BRACES. (See Braces, Trench)

TRENCH EXCAVATORS, (see Excavators, Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

TURBINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TURNTABLES FOR MOTOR TRUCKS
Blaw-Knox Co., Pittsburgh, Pa.
Champion Eng. Co., Kenton, O.
The Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

USED MACHINERY
(See Contractors' Used Equipment.)

VALVE CONTROL APPARATUS, ELECTRIC
Payne Dean, Ltd., New York.

VALVES, GATE AND INDICATOR POSTS
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Wks., Chattanooga, Tenn.
Crane Company, Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VALVE BOXES AND HOUSINGS
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Ludlow Valve Co., Troy, N. Y.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
Pratt & Cady Co., Inc., Hartford, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VENTILATORS
American Blower Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS. (See Dump Carts and Wagons.)

WAGON BODIES. (See Dump Bodies)

WAGON LOADERS. (See Loaders, Gravel and Wagon)

WALLBOARD
*Carey Co., Philip, Cincinnati, Ohio.
Beaver Board Companies, Buffalo, N. Y.
Bird & Son, inc., E. Walpole, Mass.
Cornell Wood Products Co., Chicago, Ill.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., New York, N. Y.
Plastergon Wall Board Co., Buffalo, N. Y.
United States Gypsum Co., Chicago, Ill.
Upson Co., The, Lockport, N. Y.
Waldorf Paper Products Co., St. Paul, Minn.

WALL TIES
Concrete Steel Co., New York, N. Y.
Consolidated Expanded Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

WATER MAIN CLEANING
*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., East Orange, N. J.

WATER METERS. (See Meters, Water.)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Anti-Hydro Waterproofing Co., Newark, N. J.
Atlantic Refining & Asphalt Corp., Phil'a, Pa.
Barrett Company, New York.
General Fireproofing Co., Youngstown, O.
Master Builders' Co., Cleveland, O.
Minwax Co., The, New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sandusky Cement Co., Cleveland, O.
Servicised Products Co., Chicago, Ill.
Sonneborn Sons, Inc., New York.
Tock Brothers, New York.
Truscon Laboratories, Detroit, Mich.

WATER PURIFICATION. (See also Filters.)
*Wallace & Tiernan Co., Inc., Newark, N. J.
Electro Bleaching Gas Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.
R. U. V. Company, New York.

WATER REGULATORS
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., Decatur, Ill.
Pacific Flush Tank Co., Chicago, Ill.

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewell Filtr. Co., Nutley, N. J.
Permutit Company, New York
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons, W. B., Pittsburgh, Pa.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

WATER WASTE DETECTION
*Clark & Co., H. W., Mattoon, Ill.
*Pitometer Co., New York
Simplex Valve & Meter Co., Philadelphia, Pa.

WATER WHEELS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Smith Company, S. Morgan, York, Pa.

WATER WORKS PUMPS (See "Pumps, Centrifugal" and "Pumps, Deep Well")

WELDING APPARATUS
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland, O.

Milburn Company, Alex., Baltimore, Md.
Oxweld Acetylene Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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Cook, Inc., A. D., Lawrenceburg, Ind.
Johnson, Edw. E., Inc., St. Paul, Minn.

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American Well Works, Aurora, Ill.
Armstrong Mfg. Co., Waterloo, Iowa.
Leidecker Tool Co., Marietta, Ohio.
Loomis Machine Co., Tiffin, Ohio.
Sanderson Cyclone Drill Co., Orrville, Ohio
Sparta Iron Wks. Co., Sparta, Wis.
Star Drilling Machine Co., Akron, O.

WHEELBARROWS

*Puffer-Hubbard Mfg. Co., Minneapolis, Minn.
*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, O.
Jackson Mfg. Co., Harrisburg, Pa.
Lansing Co., Lansing, Mich.
Sidney Steel Scraper Co., Sidney, O.
Steubner Iron Wks., G. L., L. I. City, N. Y.
Toledo Wheelbarrow Co., Toledo, O.

WINCHES

Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Clyde Iron Wks., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

WINDOW FRAMES AND SASH. (Metallic.)

*Truscon Steel Co., Youngstown, O.
Bayley Co., Wm., Springfield, O.
Detroit Steel Products Co., Detroit, Mich.
Friedrich Co., E. H., Holyoke, Mass.
Lupton's Sons Co., David, Philadelphia, Pa.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Sykes Co., Chicago, Ill.

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American Steel & Wire Co., Chicago, Ill.
Copper Clad Steel Co., Rankin, Pa.
General Electric Co., Schenectady, N. Y.
Habirshaw Elec. Cable Co., Inc., N. Y.
Hazard Mfg. Co., Wilkesbarre, Pa.
Macwhyte Co., Kenosha, Wis.
National India Rubber Co., Bristol, R. I.
New York Insulated Wire Co., New York.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Safety Ins. Wire & Cable Co., New York.
Simplex Wire & Cable Co., Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.
Tubular Woven Fabric Co., Pawtucket, R. I.
Waterbury Co., New York.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE GLASS

Mississippi Wire Glass Co., New York.

WIRE MESH REINFORCEMENT

*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Wickwire Spencer Steel Corp., New York.
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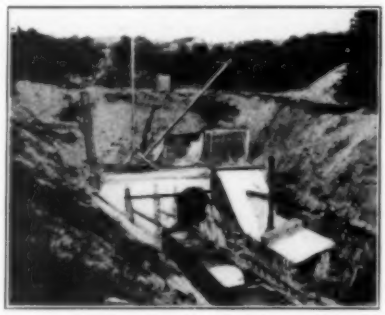
Lining a tunnel under traffic

WITH the aid of a Ransome Pneumatic Concrete Mixer, Westinghouse, Church Kerr & Co., Inc., successfully handled a job some time ago that attracted considerable attention in the engineering profession. The place was the Coulter Tunnel, 110 miles northeast of Pittsburgh on the Pittsburgh and Shawmut R. R. Contract called for a concrete lining in the 2,000-ft. timber tunnel to be put in place **without interfering with the normal traffic.**



All concrete was placed by a Ransome Pneumatic Mixer installed alongside the track just beyond the portal and delivered at an average of 10 yards per hour. A six-inch steel pipe with one 22-degree bend handled the discharge. The maximum pipe length of 2,000 ft., terminating in a 30-ft. rubber hose, was laid the full length of the tunnel at the beginning of operations and shortened as each form was concreted.

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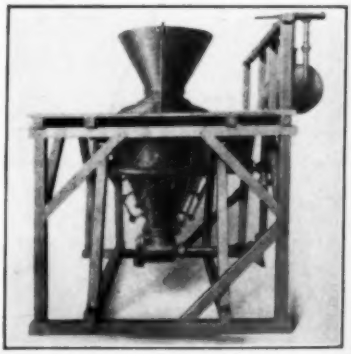

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Great Notch Tunnel and Approaches of the Wanaque Project

Building the Project Which Will Furnish Additional Water for Newark, N. J.

By Joseph A. Ward

Senior Assistant Engineer, North Jersey District Water Supply Commission

THE Wanaque Project, which will furnish an additional water-supply to the city of Newark, N. J., and neighboring municipalities, is being developed by the North Jersey District Water Supply Commission, as a constructing and operating agent under a state law.

The essentials of this project are a dam in the vicinity of Midvale, N. J., across the Wanaque River impounding approximately 28,000,000,000 gallons of water, and a conduit from this dam discharging, by gravity, into Belleville Reservoir in the city of Newark, N. J. Off this main conduit, branch lines will lead to the various communities served. This main conduit, about 25 miles in length, will be carried in a generally southerly direction from the Wanaque Dam, following approximately the contour of the ground until it reaches Watchung Mountain near Great Notch, where it will pass through a grade tunnel about 9,300 feet in length. South of the tunnel there will be about 4,300 feet of cut and cover concrete grade aqueduct, from which point the conduit will again follow the general ground contour until it reaches the Belleville Reservior.

Up to this time the concrete core wall for the dam has been put in, and carried up to about 20 feet above the average ground level, the southerly end of the core wall being omitted to allow passage for the Wanaque River. Work is now under way at this point to provide a double-barrel control conduit to carry the flow of the stream, and to permit the running of construction trains from the up-stream to the down-stream side of the dam during the completion of the core wall and embankments.

Of the main conduit, Wanaque Dam to Newark, the portion at present under contract is the "Great Notch Tunnel and Approaches,"

EXCAVATION BY HAND METHODS ON THE SOUTH CUT AND COVER AQUEDUCT IN THE WANAQUE PROJECT

THE SOUTH PORTAL OF THE WANAQUE TUNNEL

known as Contract No. 3. This contract was let in October, 1922, forty-four months being allowed the contractor to complete the work. It provides for the construction of Great Notch Tunnel, 9,300 feet in length, several stretches of cut and cover aqueduct aggregating 4,300 feet in length, and two stretches of reinforced concrete pressure aqueduct, also boat-holes, manholes, a blow-off chamber, an overflow weir, provision for future connections to other aqueducts and pipe lines crossed by the line of this aqueduct and other minor structures. This contract was let at this time so that the use of the project, as a whole, need not wait upon the completion of the tunnel and also so that the contractor could prosecute the tunnel driving at a speed consistent with the greatest economy.

The northerly 3,000 feet of the tunnel will be driven through trap rock, while the remainder will pass through shale and sandstone. Of the approaches, the southerly approach, about 3,700 feet, will be largely in sandstone rock, the depth of the trench ranging from about 4 to 20 feet. The northerly approach, about 600 feet, will be an all-earth section, with trench depths ranging from 1 foot to 20 feet. The tunnel, as well as the approaches, is being built on a grade of 2 feet per mile and designed to carry a maximum of 90,000,000 gallons of water per day.

Three Sections—Tunnel, Aqueduct and Open Cut

Three different sections are included in the work. The tunnel, which will be lined with concrete, will have inside measurements of 7 feet wide by 7 feet high. It will be horseshoe in shape, having a semi-circular arch of 3 feet 6 inches radius, the invert and lower side walls having a radius of 7 feet. The aqueduct in open cut will be of concrete 7 feet high, by 7 feet 2½ inches wide; inside, the arch will have a radius of 2 feet 8½ inches, the side-walls a radius of 6 feet 8 inches, and the invert a radius of 13 feet; the pressure section of the aqueduct is circular with an inside radius of 3 feet 6 inches. In general, the open cut aqueduct will have concrete 7 inches thick at the crown, 10 inches at the invert, and about 12 inches at the springing line; in the pressure sections reinforcement will be used. Transitions not less than 6 feet long will connect the different types of sections.

By using an extra set of ribs and special filler pieces, the contractor in connection with the designers for the Blaw-Knox Company has developed a single set of steel forms which can be used for tunnel, open cut, or pressure type.

The entire tunnel will be driven from the two portals. There is one 55-degree curve in the tunnel, which is about 200 feet from the South Portal. To date, the contractor has erected power-plants at each portal; has excavated about 1,500 feet of tunnel at the north end and about 250 feet at the south. On the cut and cover aqueduct about 500 feet has been excavated in shallow cuts to subgrade.

Contractor's Power-Plants

The contractor's first problem was to provide a power-plant at each portal. The contract permits the use of electricity, compressed air or hydraulic power in the tunnel, but not steam; also provision must be made for ventilating the tunnel and lighting it with electricity, one 50-watt lamp for each 35 feet of tunnel being specified.

Electric power in sufficient quantity to operate the compressor and other machinery could not be purchased from the local electric company, so a 165-horse-power semi-Diesel engine, made by the Anderson Manufacturing Company, was installed at each portal and is used to drive the belts on the following machinery: an 877-cubic-foot Ingersoll-Rand Imperial type compressor furnishing air at 100 pounds pressure for drilling, pumping, mucking, and drill sharpener; a 930-cubic-foot Connersville blower which is used to ventilate the tunnel; a 20-kw., 125-volt, d.c., 2-wire system General Electric generator, used for lights in tunnel and to

charge storage battery locomotives; also a small pump to circulate cooling water for the engine.

While the power-plant at the north portal was being erected, a No. 18 Osgood steam shovel was busy excavating the portal cut. The start of this cut was made at a point about 150 feet down-hill from the portal, and at an elevation low enough to give gravity drainage from the tunnel subgrade at the portal. This point also being adjacent to the site chosen for a muck pile, gave a short haul from tunnel to dump.

Work in the Tunnel

The first hundred feet in from the north portal, the tunnel was driven through part earth and part rock. This was done by the heading and bench method. The heading was driven first in the earth, and timbered with 10- by 10-inch three-piece arches spaced 4 feet centers, resting on 10- by 10-inch by 16-foot wall plates, and lagged with 2-inch lagging, the timbering being kept within 4 feet of the face at all times. As soon as an all-rock heading was reached, which made further timbering unnecessary, the bench was taken up and the timber posted down. This was a rather particular job, for the dense trap rock does not break readily and the heavy shooting made it necessary to give particular attention to protecting the timber to keep from dislodging it and precipitating a cave-in. The rest of the progress to date at the north end has been made by drilling and shooting the entire face at one time.

In payment for tunnel excavation, two lines are customarily set up, known in this case as the "A" and "B" lines. The "A" is the line within which no rock or support of any kind is allowed to project; it is the minimum excavation line and is 5 inches outside of the finished tunnel lining. The "B" line delimits the excavation to be paid for regardless of the areas of the sections actually excavated, and is placed 9 inches outside of the "A" line. The desired excavation would be just to the "A" line.

To date, the actual excavation is somewhat in excess of the "B" line. The ventilation of the tunnel is very well taken care of by the pressure blower previously mentioned. The ventilation pipe is 6¼ inches, light weight steel well casing in 20-foot lengths, with dresser joints. This sort of pipe has many advantages for tunnel work. It is light (two men can easily handle the 20-foot lengths), it is very strong, will stand high pressures, and the joints are flexible, allowing the pipe to be fitted snug to the side-wall at all times. The joints are easily kept tight and any section may be removed and replaced without disturbing any other section.

Drilling of the face is done with three Ingersoll-Rand water Leyner No. 248 drills mounted on two vertical columns. Air is furnished the drills through a 4¼-inch steel well casing pipe line with dresser joints at 100 pounds per square inch. Water is provided by a 2-inch pipe line and at about 50 pounds per square inch. All pipes in the tunnel are carried low down on the left side. High up on the right is the electric light and power line. The wires for blasting are carried high up on the left.

The drill steel used is 1¼-inch round, made up with a standard rose bit. Two-foot changes are used, with ¼-inch drop in gage for each change. The 8-foot steel is generally the maximum length used, though some 9-foot lengths have been used.

The entire face is drilled with a round of 20 holes, 6 cut holes, and a central splitter, 4 relievers, and 9 trimmers. The 6 cut holes and splitter which take out a centre wedge are loaded and fired twice, and occasionally the third time before they pull to the bottom of the holes, giving the desired advance of about 7 feet. The relievers and trimmers are then loaded and fired successively by means of electric delay fuses.

Between 7 and 8 pounds of 60 per cent gelatin dynamite are being used per cubic yard of rock broken. This is a rather high powder factor, but the excess powder shatters the rock into such uniformly small fragments that the mechanical loader used in mucking is enabled to work to its best advantage.

To date, powder fumes have caused but slight delays or annoyance. The drilling shift is allowed 8 hours to drill, load and shoot a round, making about a 7-foot advance. This is ordinarily accomplished well within the 8-hour limit, so that when the mucking shift comes on, they have immediate access to the tunnel. Should the shot be delayed, the muckers are not allowed in until 20 minutes after the last shot has been fired. About 1,500 cubic feet of free

TIMBER SECTIONS OF WANAQUE TUNNEL AT SOUTH PORTAL

air per minute is available after shooting to clear the heading of poisonous powder gases, this air being the combined flow from ventilation blower and compressed air jets.

Mucking Controls Speed of Driving

Mucking, more than any other operation, determines the economic speed at which the tunnel can be driven. Drilling, loading, and shooting are fixed operations and consume practically no more time at 1,000 or 3,000 feet in from the portal than at the portal. Mucking, however, means that for every foot of advance, two feet are added to each round trip to the dump. Hand mucking is slow, and, in these times of high labor costs, too expensive and uncertain. In this small tunnel driven in hard rock, which means many changes of steel and reduced drilling speed, it has not been found economical to have drillers and muckers working together, at or near the face. It was desired to get two shots per day, and to do that with an 8-hour drilling shift the muck must be cleaned out in four hours or less. This is now being done with a Hoar mechanical shovel which is operated by air. It has a 4-cubic-foot dipper, of standard steam shovel design, on the end of a dipper stick; the dipper is dropped to the bottom of the muck pile, crowded into it, raised, drawn back over the body of the machine, swinging then through any portion of a complete circle, extended over the discharge point and dumped by a tripping latch. It performs very efficiently in confined underground workings the kind of work done in the open by steam shovels.

To cut down to a minimum the number of trips to the muck pile, a 3-yard side-dump car 12 feet long is being used. The shovel cannot load this car direct because the dipper has only a 5-foot reach. To overcome this, a belt conveyor has been introduced, onto which the shovel discharges, the conveyor in turn discharging into any part of the 12-foot car which is spotted under it. This car is hauled to the muck pile by a 4-ton Atlas combination storage battery locomotive running on a 24-inch gauge 20-pound track. Seven to nine cars clear the heading.

Very little water was encountered in the first 1,000 feet of tunnel at the north end, but since then it has been found necessary to install a pump in a chamber blasted from the side of the tunnel and about 75 gallons per minute are now being pumped continuously.

Driving Easier at South Portal

At the south portal, operations are being carried on under very different conditions. Here the excavation is in a soft sandstone and shale rock carrying considerable quantities of water. The first 400 feet in from the portal will have but 10 to 15 feet of cover, 2 to 4 feet of this cover being earth. Grove Street crosses the tunnel about 100 feet from the portal, and 200 feet further north the Yantecaw River crosses. The contract provides that the portion between the road and river should be done in an open cut trench. The contractor, however, is tunneling the entire distance, figuring that the single operation of tunneling can be carried on continuously more economically than by combining open cut and tunnel operations in such short sections. Half of this 400 feet of shallow cover tunnel has been driven, the entire distance has been timbered with 10- by 10-inch three-piece arch rings set 4 feet center to center, except that under Grove Street the spacing was 3 feet center to center, all with 2-inch lagging. The arch timbers are supported on 10- by 10-inch by 12-foot wall plates supported in turn by short posts.

About 300 gallons per minute are now being pumped, from the tunnel excavation, from a sump near the portal. A 6-inch centrifugal pump, belt connected to a 10-horse-power electric motor, is in position for emergencies, the permanent pumping outfit being a centrifugal pump rated at 1,000 gallons per minute under 40 feet of head, belt driven from the Anderson oil engine.

It is expected that the water will increase in volume and that timbering will be necessary for at least 400 feet in from the portal, after which the rock will become firmer, carrying less water, and need little or no support.

Open Cut Operation

Open cut operations are still in an experimental stage. The line for the greater part of its length passes through swamp land close to the bed of the Yantecaw River. Soft sandstone rock, carrying considerable quantities of water, in cuts from 3 feet to 20 feet, offers various possibilities in its excavation. At present, light blasting with 40 per cent dynamite is being done to shatter the rock. After blasting, the shallow cuts are excavated by hand, while in the deep cuts a Hoar shovel of the same size and capacity as is being used in the tunnel is in use.

No concrete forms have been delivered on the job as yet, and no time has been set for the beginning of concreting operations.

Progress at present in the tunnel is about 300 lineal feet of excavation per month at the north end, and 150 lineal feet per month at the south end. On the open cut portion of the contract, rock is being excavated at the rate of about 1,500 cubic yards per month.

The Commission and Engineering Personnel in Charge of Wanaque Project

The North Jersey District Water Supply Commission consists of Laurent J. Tonnelle, Chairman, Wood McKee, Thomas L. Raymond and Berkley W. Moore, Jr. Morris R. Sherrerd is Consulting Engineer, Arthur H. Pratt, Chief Engineer; Neil C. Holdredge, Assistant Chief Engineer, in charge of construction; Arthur L. Sherman, Designing Engineer, and Joseph A. Ward, Assistant Engineer, in charge of construction on this contract. The contractors are Heyman and Goodman of Jersey City, N. J., and Robert Parker is General Superintendent.

TYPICAL SCENE ON THE DARTFORD-STROOD ROAD, SHOWING RUSTON STEAM SHOVEL AT WORK

Rebuilding an Old Roman Road in Kent, England

Tortuous Lane from Dartford to Strood Rebuilt as a Bituminous Road

A RECENT issue of *Roads and Road Construction*, London, England, contains an interesting story of the reconstruction of the old Roman road in Kent from Dartford to Strood, which we take pleasure in reprinting in part with permission, in order that our readers may know something of the road construction work which is going on across the water.

Good modern highways are a necessity of the times in England as well as in the United States, and in Kent with its narrow, tortuous lanes, the necessity is perhaps as apparent as in any part of England. The Kentish lanes are in many cases real beauty-spots, ideal for a summer ramble, but with the ever-increasing modern motor traffic they are a source of danger to the traveling public. The Ministry of Transport under Sir Henry Maybury tackled the subject of new road construction in Kent, and the acute unemployment question gave the necessary impetus, resulting in the construction, among others, of a new arterial road about twelve miles long from Dartford to Strood. Sir Henry Maybury was able to adopt his well-known policy of making this road of bold lines through more or less virgin ground where he was not hampered by old-fashioned but picturesque villages, with their out-of-date narrow roads.

The country through which this road is built is very undulating, not to say hilly, which is exemplified by the fact that the highest altitude is about 300 feet above sea-level, while the lowest is about 60 feet. The alignment of the road did not offer many difficulties, as long tangents joined by long curves, the minimum radius of which has been fixed at half a mile, have been possible, on account of following the old Roman road, as the Romans always made their roads as straight as possible. The gradients have been made as easy as possible considering the nature of the country, the maximum being 1 in 25 and the minimum about 1 in 50, with vertical curves of about one mile radius at the junctions. The results should be a well-drained, dry road with easy traveling.

At Swanscombe Park, about three miles from the Dartford end of the road, the ground rises to over 300 feet above sea-level, and here it has been necessary to excavate one of the largest, if not the largest, cut ever made in England, removing about 600,000 cubic yards of earth. Four of the largest type English steam shovels have been used, with attendant locomotives, trucks, railways and sidings, until this area about one mile long looks much like an industrial site. Near this point the road will pass under the Southern Railway near Southfleet by a bridge of 100-foot span. The new roadway is being made 100 feet wide between the fences, the carriageway being from 30 to 40 feet wide, with wide footways on either side. It is the intention to plant trees in these footways to form an attractive boulevard. The far-sighted policy of the Ministry of Transport in taking sufficient land to allow for widening the road in the future is to be commended. The carriageway is made up of 3 inches of hard clinker spread and rolled on the subgrade, which has previously been rolled to the desired crown. "Hardcore" is then deposited and repeatedly rolled with 10-ton road rollers to consolidate it to 9 inches thickness.

Water-bound flint macadam of 3 inches consolidated thickness forms the first surfacing, and this will in turn be covered with 3 inches of bituminous surfacing. A 12- by 6-inch concrete curb runs along either side of the road. The construction of the new road began in January, 1922, and is expected to be completed in June, 1924.

The total excavation amounts to nearly 1,500,000 cubic yards. About 120,000 tons of aggregate will be used in the construction of

the roadway alone. Thousands of trees had to be cut down to clear the site, but care was taken to do only as much of this as was absolutely necessary. Nearly 2,000 men have been constantly employed, almost all of whom have come from the London area and have been transported by special trains to and from the work and their homes. The benefits to skilled and unskilled labor by the construction of this and other roads are immediate, but the benefit to the nation and the community at large is incalculable and will only be appreciated later.

The construction of the road will shorten the journey from London to Chatham and the sea by nearly three miles and by an equivalent of double that mileage in time by saving the detour through Gravesend, where the roads are narrow and twisted.

Captain W. E. Smith of the Ministry of Transport is the Resident Engineer in charge of the operations, and it is to him and *Roads and Road Construction* that we are indebted for the article and illustrations. The contractors for the work are the well-known firm of Sir Robert McAlpine & Sons, of London and Glasgow, who have carried on many large construction projects in England and other countries.

A COMPARISON OF THE WIDTH AND GRADIENTS ON THE OLD AND NEW ROADS BEING BUILT IN KENT, ENGLAND

An Interesting Bridge Case

Does Increasing Height of Piers Weaken Structure?

CAN a steel railway bridge be increased in height 7 feet and yet not weaken the concrete piers supporting the superstructure? This question is now being threshed out in the courts of Canada, and the case may eventually go to the Privy Council in London, the court of last resort in the British Empire.

The Dominion Bridge & Construction Company received the contract for erecting the steel superstructure of a bridge over the mouth of the St. John River in New Brunswick. The Canadian Pacific Railway engineers exercised a general supervision over the work, including the building of the concrete pillars, standing 100 feet high. The bridge is now one of the most important railway bridges in Canada, and one of the most costly of the Canadian Pacific chain of bridges.

It was not until the bridge was completed and had replaced a cantilever bridge that had outgrown its usefulness, that a protest was entered against the height of the bridge. Shipping interests and lumber exporters of the New Brunswick district contended that schooners passing under the bridge en route to or from the United States, in quest of, or loaded with, lumber, stone, lime, soft coal, pulpwood, etc., lost part of the masts.

In consequence of complaints by the shipping and lumber companies, the Attorney General of New Brunswick instituted action against the Canadian Pacific Railway to compel the railway to increase the height of the bridge 7 feet. The case was vigorously defended by the railway. The railway engineers contended that to increase the height of the bridge would be to weaken the supports. The engineers and contractors called as witnesses by the plaintiffs asserted there would follow no weaknesses in the supports if the height were increased. The presiding justice gave verdict in favor of the railway. The case is to be appealed to the Supreme Court of New Brunswick and then to the Supreme Court of Canada. Years may elapse before the mooted question is settled definitely. In the interim, the building of an overhead approach and the paving of the street are held up.

LEGAL POINTS FOR CONTRACTORS

These brief abstracts of legal decisions in the contracting fields may aid you in avoiding similar difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street, Attorney-at-Law

Liability of Contractor's Sureties on Labor and Material Claims

That a statute may require a public contractor to give bond for the payment of labor and material furnished him in the performance of his contract, and that the instructions to bidders under which the contract was awarded may have specified that such bond would be required, does not make the contractor's sureties so liable where the bond delivered did not provide for the payment of such claims. In so holding in the case of United States vs. Stewart, 288 Federal Reporter, 187, the United States Circuit Court of Appeals, Eighth Circuit, observed that "an obligation to furnish is not an obligation to pay for material that will be furnished." It was further remarked that the sureties' obligation was that signed by them, they not being parties to the contractor's contract. On his furnishing the material and work required under the contract, the obligation for which they became sureties, they were discharged from responsibility.

Concessions to Highway Contractor Did Not Vitiate Agreement

In the case of Owen vs. Fleming-Stitzer Road Building Co., 250 Southwestern Reporter, 1038, plaintiffs unsuccessfully assailed a county highway construction contract. Among other points decided in the case, the Texas Court of Civil Appeals held that it was not illegal for the county to obligate itself to furnish equipment for use by the contractors and to be paid for by them as the work progressed. The opinion seems to treat the general powers of the county authorities to lay out and establish roads as being broad enough to impliedly warrant such an arrangement. Legislative sanction for the arrangement is, however, held to be more clearly manifested in statutes authorizing the county commissioners to purchase or hire necessary road machinery, tools, teams, etc., required to grade, drain or repair the roads, and to make reasonable orders for laying out and improving the roads. It was further decided that the contract was not invalid in providing that the county should pay the premium on the contractors' bond.

An Aspect of Transportation of Contractor's Equipment

Plaintiff, a road contractor, shipped an outfit to Norfolk, Va., over defendant railway company's line under a standard bill of lading which provided for transportation subject to existing tariffs, etc. A private siding was designated as the specific destination, but in order to make delivery there it was necessary that the car pass over the lines of two switching companies. The tariffs in force provided that a shipment should not be delivered to a switching line until all charges were paid. Plaintiff refused to pay until the car was spotted on the siding, and demurrage accrued. He then sued for damages on a theory that the defendant had wrongfully converted the outfit by refusing to spot the car for unloading.

But in the case of McGuire vs. Atlantic Coast Line Railroad Co., 118 Southeastern Reporter, 225, the Virginia Supreme Court of Appeals ruled that there could be no recovery by plaintiff.

It was decided that tariffs referred to in a bill of lading, to which the bill of lading is made subject, become a part of the contract; and that it would have been an unjust discrimination against other shippers and a violation of the Transportation Act to have released plaintiff from compliance with the tariff requirement for payment of charges before delivery of the car to the switching lines.

Status of Hauling Subcontractors

Stephens, a bridge contractor, arranged with Westlake for the latter to haul a required quantity of sand to a bridge site at specified compensation per cubic yard. While hauling the sand Westlake was injured and claimed compensation under the California Workmen's Compensation Act; the accident occurring under employment in that state.

The Industrial Accident Commission ruled that an award was proper, but on reviewing the case the California Supreme Court annulled the award. (Stephens vs. Industrial Accident Commission, 215 Pacific Reporter, 1025.) The Court said:

"Westlake pursued his own course in hauling the sand. Stephens gave him no directions other than to show him the place from which it was to be taken and where delivered. Westlake was free to come and go as he pleased, using as many or as few wagons as he chose. No supervision, direction, or control of any character was exercised over his movements. He was left to do his work in his own way, by his own methods, and with his own teams. Under these facts, concerning which there is no dispute, Westlake was unquestionably an independent contractor."

Right to Lien on Account of Tools, etc., Used on Contract Work

"It is well settled," declared the Wisconsin Supreme Court in the recent case of Webb vs. Lee, 194 Northwestern Reporter, 155, "that in actions to enforce liens, materials used by a contractor as mere appliances or tools or equipment, and which may be used again in the construction of other buildings or structures, are not materials for which a [mechanic's] lien can be enforced.

"The rule is different if the materials have lost their identity or fitness for future use to any material extent. . . . In Moritz v. Sands L. Co., 158 Wis. 49, 146 N. W. 1120, 51 L. R. A. (N. S.) 1040, lumber used for shoring was furnished the contractor, and it was found that 75 per cent of it was consumed in the construction of the building and could not be used again; that 25 per cent of the lumber was not consumed, but that it had become depreciated in value. The amount of this depreciation was determined, and a lien was allowed for the amount of the depreciation of the 25 per cent, and the 75 per cent actually consumed.

Right to Release from Bid Under Mistake

Where one receives a bid for materials, knowing that the bidder has probably made a mistake in his proposal, the latter is entitled to have the contract formed by acceptance of his bid canceled, according to the decision of the Maine Supreme Judicial Court in the case of Hudson Structural Steel Co. vs. Smith & Rumery Co., 85 Atlantic Reporter, 654. That was a case where one bidding to furnish a contractor with roofing material innocently misunderstood that he was bidding on one building only, instead of two. The Court found that the other party was an experienced contractor and that he must have known that the bid was made under mistake.

But it was decided by the Wisconsin Supreme Court in the case of Grant Marble Co. vs. Abbot, 124 Northwestern Reporter, 264, that a contractor's mistake in figuring on finishing five stories of a building, instead of six, did not entitle him to release from his contract unless he could show that the owner was apprised concerning the mistake when the bid was accepted.

Contractor as a Buyer of Materials

Delay of road contractors in objecting to the quality of cement delivered to them was held by the Michigan Supreme Court (192 Northwestern Reporter, 787) to preclude them from resisting liability for the purchase price on the ground. The Court said:

"If it was below the standard of strength it was the duty of" the buying contractors "to so advise the cement company within a reasonable time if they desired to escape payment for it. . . . This they did not do. They apparently paid no attention to the notice of the state highway commissioner" concerning the quality of the cement being used, "retained and used the carload the same as the rest without complaint or notice to the cement company for over two years after being advised by the state, and not until sued for its value."

Defective Performance of Contracts

One of the most interesting court decisions bearing on the right of a contractor to recover for construction work without obligation to replace materials not conforming to the agreement is to be found in the case of Jacob vs. Kent, 129 Northeastern Reporter, 889, decided by the New York Court of Appeals.

Plaintiff built a country residence for defendant at a cost of more than $77,000 and sued to recover an unpaid balance of about $3,500. After the building had been constructed, it was found that pipe constituting part of the plumbing was not "of Reading manufacture," as required by the contract. And to have replaced the pipe to conform to this requirement would have involved demolition of substantial parts of the building, at great expense, as well as expense in replacing the pipe. It was held that there was substantial compliance with the contract, and that the contractor was not bound to replace the pipe. In the course of its opinion, the Court said:

"The courts never say that one who makes a contract fills the measure of his duty by less than full performance. They do say, however, that an omission both trivial and innocent will sometimes be atoned for by all allowance of the resulting damage, and will not always be the breach of a condition to be followed by a forfeiture. . . .

"In the circumstances of this case, we think the measure of the allowance is not the cost of replacement, which would be great, but the difference in value, which would be either nominal or nothing. . . . . It is true that in most cases the cost of replacement is the measure. The owner is entitled to the money which will permit him to complete, unless the cost of completion is grossly and unfairly out of proportion to the good to be attained. When that is true, the measure is the difference in value. Specifications call, let us say, for a foundation of granite quarried in Vermont. On the completion of the building, the owner learns that, through the blunder of a subcontractor, part of the foundation has been built of granite of the same quality, quarried in New Hampshire. The measure of allowance is not the cost of reconstruction. 'There may be omissions of that which could not afterwards be supplied exactly as called for by the contract without taking down the building to its foundations, and at the same time the omission may not affect the value of the building for the use or otherwise, except so slightly as to be hardly appreciable.' . . . The rule that gives a remedy in cases of substantial performance, with compensation for defects of trivial or inappreciable importance, has been developed by the courts as an instrument of justice."

Building to Last, Not to Burn---Part II

The Story of the Work of the Underwriters' Laboratories in Determining the Fire-Resisting Qualities of Different Building Materials

PARTITIONS used for the subdivision of fire sections of buildings are of considerable value in safeguarding life and preventing the rapid spread of fire through buildings. As retardants, these doors need not possess the qualifications required for the protection of openings in fire-walls, in vertical shaft walls or in walls of rooms containing specially hazardous processes, but they should be capable of furnishing a substantial barrier to the passage of fire, and should fulfill all service requirements. This last means a great deal, because these interior partition doors are very frequently used.

Many types and patterns of fire-doors listed for protection of openings in fire-walls or in vertical shafts are suitable for corridor or room partitions. These doors can be used in this situation, and Underwriters' Laboratories labels them accordingly. While in the preceding classes no glass is allowed, in this class standard wired glass is permitted, but the exposed area of individual glass lights must not exceed 1,296 square inches. The use of glass is, of course, a great convenience in this situation, but when equipped with glass panels, fire-doors afford a limited resistance to fire and fire-streams.

Doors for Openings to Exterior Fire-Escapes

Here we have special reference to the escape of people from burning buildings. This may take place under panic conditions and with but few seconds to spare. What, then, is the very first requirement for a door so placed? Undoubtedly, that it must be "capable of being readily operated from the inside of the building."

There are additional requirements, however. Such a door is exposed to the weather and must not deteriorate for a long period. Furthermore, it becomes a part of the outside wall of the building and must protect its opening from outside fire exposure. "Only such fire retardants are included in this class," reads the official wording, "as have been shown by experience and tests to be capable of furnishing a high degree of fire protection against fire exposure where mounted on one side of the wall only."

Doors for Openings in Exterior Walls

The final situation for fire-doors includes fire-retardant shutters as well. Obviously, the protection furnished in this situation must be against external fires. In congested city districts or in other cases where the neighboring exposure is severe, this protection is of the greatest importance and bears on the fearful conflagration problem.

There is a large variety in listed fire-doors and shutters for exterior walls, including some which are almost invisible when open and which can be used to protect the most beautiful building without marring its appearance. Several types are automatic; in general, this implies a fusible link on the outside which melts when exposed to fire and allows the shutter to close. Some of the shutters have a "manual test release" which can be operated by the building superintendent on his periodic inspections, or by officials of the municipality or representatives of insurance companies.

From the foregoing outline of the many types of fire-doors listed by the Laboratories, it may readily be seen that the Laboratories' work, even though distributed over a number of years, has of necessity been intensive. It has resulted in a great improvement of all kinds of fire-doors and shutters, and in the creation of new kinds.

Its effect has been particularly marked in re-

THE FIRE STREAM TEST OF A METAL WINDOW FRAME
The movable wall containing the metal window frame has just been rolled from the furnace and the glowing window is being deluged with a fire stream on the side of it which has been exposed to fire in order to demonstrate whether it will withstand the impact and the sudden contraction of parts caused by the cooling effect of the water

lation to the widely manufactured tin-clad doors, whose standard of construction is far more exacting to-day than was the case a few years ago; in fact, the earliest doors of this type showed so much distortion under the fire that they failed to cover the opening. Another difficulty was found in the puffing of the tin from the pressure of gases formed in the wooden cores. It was finally suggested that a circular hole be cut in the tin on the exposed side of the door. This proved successful. Doors provided with such openings retained their shape much longer, and during fire tests the gases could be seen bursting in a jet of flame from the frame.

Sometimes, indeed, the consideration of doors involves other phases than that of fire resistance. One incident is told at the Laboratories of a manufacturer who submitted a rolling door for outside installation in warehouses and barns. He was told that his outside door was all right, save in one respect—it was not "sparrow-proof." Taking this comment as a joke, he disregarded it, but in six months confessed his mistake, saying that he was beginning to receive many complaints because the construction permitted an opening which was promptly accepted by sparrows as an invitation to build their nests under shelter from the weather. The nest litter prevented the closing of the door and was an entirely valid point of criticism. This, however, is hardly a typical example.

A door-opening, to be satisfactorily protected, should be provided with a labeled door, equipped with labeled hardware and mounted in a labeled frame, although, of course, labels may be applied to doors, hardware and frames separately.

Columns

Everyone who saw in the motion picture "News Weeklies" the showing of the much-discussed Chicago fire of March 15, 1922, will recall the thrilling collapse of the Atlantic Building. First, the walls began to fall from various stories, then the steel columns were seen to sag, and, finally, what was left of the building went down, while the spectators gasped. Columns are among the most important elements in the strength of buildings, and this instance is one of many in which the softening of iron and steel under heat has robbed them of strength and led to disaster.

Architects and engineers were long aware that fire protection called for some form of insulating covering for columns, and various types were produced; but so many of these failed in use that there finally arose an insistent demand for exact knowledge. Tests made by several organizations contributed some data, but also indicated that their conclusions were incomplete because of inadequate apparatus. It came to be realized that in all the world there was no piece of apparatus equal to the tremendous task. Finally, the job was taken in hand by Underwriters' Laboratories in cooperation with the United States Bureau of Standards and the Associated Factory Mutual Fire Insurance Companies.

During the years from 1912 to 1917, there was erected a huge combination of furnace and press, capable of taking a 12-foot column, loading it with a 250-ton weight to represent such portion of a skyscraper as it might be expected to support, meanwhile surrounding it with a fire as intense as the fiercest conflagration. In connection with this extraordinary test furnace, there were instruments of delicate precision for measuring and recording the loads sustained by the sample column, the temperature of the fire around it, the temperature within the column itself, the amount of sagging, bending and shortening under the influence of heat and pressure, and the distortive, and finally the disintegrating, effort of a fire-stream of cold water turned suddenly upon the hot loaded column.

While the mighty machine was being built, representative types of columns and protective coverings were collected, and during three years more than one hundred complete columns were thoroughly tested. The report of these tests fills a printed volume of nearly 400 pages.

The results of the work so far accomplished on columns may thus be summed up:

The ultimate fire resistance of all representative types of building columns, when loaded and under conditions representing those of actual service in a fire, has been ascertained.

The relative resistance to fire of various materials and methods employed for protecting building columns has been determined.

A great body of reliable data has been provided by means of which the fire endurance of the various columns can be compared; and from this information it has been possible to do a great deal of grading and classifying of types of columns and methods of fireproofing.

The effect of fire-streams on heated columns has been ascertained.

Improvements have been developed in the fire resistance of the insulation and in the methods and conditions of installation.

One of the series of tests conducted by Underwriters' Laboratories alone is of almost dramatic interest.

The lumber interests had been greatly concerned over the apparently poor showing made by wooden columns; for "mill construction," when meeting certain requirements, had always been regarded as better than unprotected steel of the same strength. Briefly stated, what astonished all experts was that certain types of wooden columns that were expected to bear a standard load while surrounded by a fire whose temperature was increased at a standard rate, and to bear that load for one hour before "failing"—the definition of "failure" also being standardized and understood by all concerned—did not live up to expectations; they "failed" after about thirty minutes instead of one hour. For two years, beginning in 1919, further tests were conducted to find out what was wrong and how to correct it, and reports were made. The solution was elusive and was not reached until the fifth report.

In studying the results of the standard tests, it was readily seen that the wooden columns failed at the ends—never in the shaft portion.

One phenomenon which might have passed unnoticed was given careful consideration: the end seemed to crush at first slowly and then much more rapidly. Now, this is the commonest of all phenomena in all tests of this sort, but it was decided to avoid the destruction of possible evidence and to study what was happening during the slow deformation. Therefore, a number of tests were stopped suddenly at various stages of deformation and, at last, after dissecting a number of samples and studying the appearance of the wood fibers, the cause was found. From the appearance of these fibers at the very ends and at various short distances from the ends, it appeared that certain conditions of moderate temperature brought about an unexpected softening—indeed, an almost plastic condition of the wood at the end. This overthrew current ideas, being a kind of failure which had never been predicted, and the next step was to find the remedy by devising an adequate end protection.

Various theories were tried out and abandoned. Finally experiments were conducted to determine whether a cap which would completely enclose the end of the column with insulating material would give better results, and to ascertain the best design for such a cap. From the first, it was seen that this was the right direction. At last, on October 30, 1919, a column failed under test, not at the end, but in the shaft portion.

Now began a new series of experiments, on full-size columns, one foot square, such as are used in many buildings. With the experience previously gained, it was possible to determine just what to do to protect the ends of the columns, and the crowning result of all was a series of tests in which every column failed in the shaft portion—not a single end failure—and, what was most gratifying, the average time of failure was not one hour, which would have entirely satisfied the lumber people, but one hour and a half!

While certain supplementary applications are still under consideration, these tests have had the amazing result of showing how the fire resistance of a wooden column may be increased 200 per cent.

Walls and Floors

While structural engineers may consider a building to be a series of platforms enclosed by walls, a fire prevention engineer is forced to regard them as large boxes in which people live, work or store goods, and which usually contain smaller boxes, called rooms. Everybody knows that boxes consist chiefly of sides, and these, in the case of rooms and buildings, are the walls and floors. It follows that a building having a high standard of roof, windows, doors and columns may still be highly combustible unless its walls and floors likewise are fire-resistive. Naturally, these come in for constant study at Underwriters' Laboratories.

Again it must be emphasized that incombustible material is not necessarily fire-resistive in use—it must be rightly used.

A single brick may survive a very hot fire for a considerable length of time, but a wall made of such bricks may be constructed so poorly that it will not stand up under a typical fire. Another wall, constructed of materials which are able to withstand high temperatures, may lose so much strength under fire that it will no longer support the floor beams. Some walls make a good showing while fires rage against them, only to crack and crumble when struck by the firemen's hose stream.

At the instance of manufacturers of various materials and of associations and official bureaus, Underwriters' Laboratories is conducting a great number of tests covering types of walls and partitions. Most of this work has not been for the labeling of products, but in the nature of research and classification of familiar types.

Investigations of the fire resistance of building materials have been conducted in Europe and America for more than half a century, by official bodies, architectural and engineering societies, and a great number of commercial bodies and individual firms. The total amount of work performed by Underwriters' Laboratories on the subject of walls, figured in total hours, represents but a small fraction of the whole, but it has proved to be the most important and authoritative.

It will no doubt take several years to complete the classification of walls with regard to fire resistance, strength and fire-hose-steamer resistance. Already a number of types of construction have been classified. That is to say, it is possible to know in advance just how

The Vision of Underwriters' Laboratories

The imaginative spectator could easily let his mind travel from the technical atmosphere of the tests carried on in Underwriters' Laboratories and see them in their ultimate human relations. He could picture the construction of great areas of workmen's cottages where cheap construction made low rents possible and furnished safe and satisfactory living conditions within the reach of small incomes. Such savings in turn translate themselves in terms of bank accounts, contentment and social security.

Doubtless one must check the play of his imagination within moderation, but doubtless, also, it is true that the heat waves of the testing furnaces at Underwriters' Laboratories set in motion impulses of sociology, economics and human welfare that travel far.

long they will endure in a typical fire before "failing"—the expression "failing" being well defined.

In the field of walls and interior partitions of lesser strength and resistance to fire, the Laboratories has achieved noteworthy results, and it is now possible for the architect to give his client definite assurance as to the performance of listed materials.

With regard to floors, the problem has been somewhat different, because the floor structure of one story involved the ceiling of the story below. Therefore, the chief work of the Laboratories has been not so much that of testing the highly resistant types as of determining the retardant value of ceilings of various fire-resisting materials applied under wooden joist construction, as in frame houses.

The intensely practical nature of the investigation is shown by certain tests that were made in April, 1922. The war and post-war conditions had resulted in a great scarcity of buildings, particularly of dwelling houses. The cost of materials and labor had checked construction, and rents, in consequence, had risen to alarming heights. Newspapers were full of the discussion; it had become a sociological question of the first rank, affecting as it did the living conditions of millions of people. There was an urgent demand for hundreds of thousands of inexpensive new houses, but the building codes of the various cities very properly forbade the increase in conflagration hazard which would have come from the usual type of cheap construction.

Here was a serious problem which the Laboratories tackled from an interesting angle. Accordingly, in April, 1922, a number of people were gathered in one of the furnace rooms to witness tests that might prove to be of far-reaching importance.

A section of partition had been inexpensively constructed by nailing metal lath to both sides of wooden studding, and coating the surface with gypsum plaster. This partition was installed in the front wall of the great vertical furnace adapted to such use and subjected to the fierce intensity of gas flames under the prescribed conditions.

At the end of the period, the partition was rolled from the furnace, and its glowing surface received the full impact of a fire-stream as might be the case in a real fire. Naturally, the power of the stream tore the plaster from the lathing, whereupon it was discovered that the wooden framework beneath had been so well protected as to have suffered less than 10 per cent impairment. In other words, such a partition would have remained relatively good after passing through a one-hour fire of more than ordinary intensity. It was not to be considered "fire-proof," of course, but it would serve as an efficient fire-barrier for a period of an hour.

Tests of a floor section of the same general type were made in a horizontal furnace and gave equally good results. In this case the test included loading the floor with weights and taking observations to determine whether there was any sagging beneath the load under the influence of the fire.

Prepared from "A Symbol of Safety," an interpretative study of the Underwriters' Laboratories, Inc., a notable institution organized for service—not profit. The book is published by Doubleday, Page & Company, New York, 1923. XIV + 290 pp. Illustrated.

Are They With, For, or Against You?

The Contractor Must Be a Leader, not a Driver, of His Men

"BUILDING labor turnover becomes extremely important when workmen are scarce," claims one well-known Pittsburgh building contractor. "When from a third to a half of a gang of mechanics at work on a building walk up to the office and quit, the actual loss in dollars and cents is startling. If they are bricklayers, it means, during these days, that a nice hole has been knocked in the time schedule.

"In my opinion, when a man has come to the point where he demands his time, it is useless to try to kid him into staying, unless he has some specific grievance which should be remedied. Even then it is usually too late in the game with that man or group of men.

"The time when labor turnover must be attacked is when the men are first coming onto the job and while they are at work there. Get them to feeling that they are working with you and not for you, and half the labor troubles on any job will be nipped in the bud. It takes a definitely outlined policy and persistent effort to get an organization to operating on a basis of cooperation. It can be done neither by being hard-boiled nor by being soft.

"The best way to make a start is to set an example for the executives. Always handle superintendents and foremen as though they were indispensable partners in the business. Use the word 'we' once in a while instead of 'I.' If you set such an example, the spirit will naturally extend itself, but if the policy of cooperation is pushed by active propaganda as well as example, then results ought to show in the response from the workmen on the job. Labor turnover will be reduced to its lowest possible figure if the job conditions and the pay are average. No one likes to work for a martinet. It is the leader and puller that will win these days rather than the driver."—*The American Contractor.*

Problems Met on a Force Account Job

By R. J. H. Worcester

Resident Engineer, New Braunfels, Texas

CONSTRUCTION work carried on by the owner of force account often presents problems not encountered by the contractor with a going organization and business. Especially is this true if the job is the first one of its kind at this particular plant.

The first, oftentimes the most difficult problem, is to build a good organization. Foremen, though they be experts in their respective lines and overflowing with energy, will accomplish little until they become well acquainted with each other's and the boss's peculiarities and welded into a harmonious family, enthusiastic for the job and loyal to the management. Until this has been accomplished, the construction engineer or superintendent will find himself busy ironing out small difficulties and dispensing enthusiasm, so necessary in this kind of work. To the man who feels that, despite the eccentricities of the human race in general and construction men in particular, the work of organizing and directing the efforts of these soldiers of progress in the erection of structural monuments is a pleasure, the difficulties presented in this problem will rapidly vanish in thin air.

The next problem, and one that will likely cause considerable thought, is that of securing necessary equipment, as in all likelihood the close of the job will wind up the need for equipment as far as the owner is concerned. He, naturally, is much interested in keeping his investment for equipment to the lowest possible amount. There are two methods of solving this equipment problem: first, by borrowing, wherever possible, whatever is of use to the job, a method which is not new—almost any contractor will admit that it was partly responsible for his successful start; second, by employing a man as master mechanic who can make whatever the job requires with whatever can be picked up and who has the disposition to do it. This latter method is considered the better of the two.

On the Planters & Merchants Mills, Inc., job at New Braunfels, Texas, both methods have been used with good results. The second, however, Lockwood, Greene & Co., has been the most favored, because of an experience with a borrowed hoist in the early days of the job. Everything was in readiness to start hoisting concrete at the power-house when the owner of the hoist needed it himself. To buy a new single-drum hoist would have cost, at the lowest figure, $325. Pulleys, shafting and a second-hand automobile clutch were purchased, together with scrap iron, bolts and oak timber, and the result, a hoist, which has raised approximately 3,000 yards of concrete (in 2-sack batches) with a lift of from 10 to 70 feet, was made up at an initial cost of $170 with about $120 repairs and the addition of a second drum for use with hoisting boom.

This hoist was operated by a single-cylinder, 10-h. p. Stover gasoline engine, purchased new at the start of the job, and used for pumping on the dam and power-house work. Both hoist and engine should bring at least 40 per cent of their first cost.

THE HOISTING APPARATUS AND SAW WHICH WERE ASSEMBLED FOR $75

This outfit, run by a second-hand engine bought for $14, shows how it is possible and sometimes necessary on the out-of-the-way job to save money

Later a power saw outfit was needed. For this a bargain was found in a second-hand Studebaker 27½-h. p. motor in good condition for $14. The necessary pulleys, mandrels and so forth for a rip-saw and emery wheel and a second-hand cross-cut for $75 were all assembled and run from this engine. This was done by building a laminated wood pulley onto the engine fly-wheel. The cost of the unit with repairs during the job totaled $340, and as it stands to-day it is ready for another good-sized job.

For fire protection and service water storage there is a 60,000-gallon tank on an 80-foot tower. The total height from the water behind the dam to the top of water-level in the tank is 154.5 feet. When the tank was erected, there arose the problem of filling it for a test. There was on hand at the time a 2½-inch vertical

centrifugal pump. Again a Studebaker motor, 27½-h. p., was purchased, this time for $35.

The engine pulley was increased to raise the pump speed about 12½ per cent, and the pump impeller narrowed on the circumference so that it would not bind because of increased speed, though it remained a close fit with the casing. The height of the center of the pump above the water is 12 feet, which leaves a lift of 143.5 feet. The suction and discharge are both 2½ inches. At the time the tank was first filled, the filling line was made up of alternate stretches of 2-inch and 3-inch pipe totaling 346 feet of 2-inch and 100 feet of 3-inch, and with a dozen fittings on the line. The entry into the tank was through the 3-inch overflow pipe. The time of pumping 60,000 gallons was 30 hours; motor speed, 600 r. p. m.; pump speed, 1,800 r. p. m.; fuel, 25 gallons of gasoline and 1 gallon of oil. This pump has kept the tank supplied with water continuously since January of this year and is now connected to the 4-inch service piping, which has increased its efficiency considerably.

A third Studebaker engine has been connected to a 4-inch pipe machine and an 18-inch drill press, with excellent results.

It is worthy of note that on all gas engine outfits a continuous water cooling system has been installed, which makes it possible to operate continuously without overheating the engines, regardless of the Texas temperatures, which often reach extreme heights.

For the arrangements above described all credit is due Major S. M. Ransopher, the owner, for taking a chance on the outcome, and J. J. Wilson, the job master mechanic, for the results.

ACKNOWLEDGMENT.—Courtesy of *Builders*, Lockwood, Greene & Co., Boston, Mass.

Asphalt Paving Exceeds Guarantees in Three Canadian Jobs

Contractor Spends $180 Maintaining 131,000 Square Yards of Pavement Over Five-Year Period

By Charles W. Dill

IN 1914-15 the National Paving and Contracting Company of Winnipeg constructed 131,000 square yards of asphaltic concrete paving under a five-year maintenance clause. At the end of the guarantee period the entire expenditure for up-keep of this yardage totaled $180, the necessary repairs being the result of unusual and difficult circumstances, and not due to any fault of the materials employed in the work. The entire yardage consisted of 2 inches of asphaltic concrete on a 6-inch cement concrete foundation. A squeegee coat with fine crushed stone was used in each of the three jobs, which aggregated the total of 131,000 square yards.

The first of these jobs was the construction of 55,000 square yards of paving for the city of Fort William, Ontario, in 1914. At the end of the guarantee period the seal coat over this paving was wholly intact and no maintenance was required.

The second job was the construction of 21,000 square yards of paving for the municipality of West Kildonan, a suburb of the city of Winnipeg, Manitoba. This yardage was constructed on the main street of the municipality and carries the heavy traffic going north from the city to historic old Fort Garry and the many extensively patronized summer resorts on Lake Winnipeg. At the expiration of the five-year period this pavement was as good as new, and not a square yard was in need of repair.

The third contract called for the construction of 55,000 square yards of asphaltic concrete for the municipality of Assiniboia, another suburb of Winnipeg. This work, which was done in 1915, represents a 5½-mile stretch of the extension of Portage Avenue, Assiniboia. It is a section of the Canadian coast-to-coast highway and consequently is subjected to fairly heavy traffic. Owing to the flat nature of the surrounding country, and the fact that satisfactory drainage was difficult to secure, a small amount of damage resulted to this pavement from heaving. We were obliged to expend approximately $180 in repairs to curb and gutters and in filling a few cracks in the pavement surface. Otherwise the pavement was in excellent condition, and it has remained so to date.

Texaco asphalt cement having a relatively high ductility at 32° F. and a penetration of 75 was used in all three of these jobs.

"Scratch My Back and I'll Scratch Yours"

NEVER before in the history of this country have business men, professional people and the laboring classes generally, appreciated the practical benefits that can be derived through cooperation. There is not a day that is not marked by the announcement in the press of the decision of some group to participate in a mutual advertising campaign, launch a new bank, or underwrite some research investigation.

To-day there are more than 6,000 associations of employers, to say nothing of the scores of professional societies and the hundreds of labor bodies. Fully a dozen large industries have selected commissioners or secretaries to serve the various factors.

Broadly speaking, cooperation merely means helping the other fellow to help you. It is a case of "scratch my back and I'll scratch yours."—*Asbestos.*

Chicken Wire Stops Accidents

Use of This Common Material Gave Men a Feeling of Safety That Added to the Efficiency of Their Work

A GENERATION ago, when everything connected with the building industry was cheap, including life, the men who worked on scaffolds gloried in the chances they could take and still get away with it. Platforms made of the poorest boards to be found on the job, material that was worthless for any other purpose, were slung on rope supports which sometimes held together until the men were safely back on the ground. Sometimes they didn't, but why worry? Plenty more men where the other fellow came from, and the clever attorney for the insurance company could prove contributory negligence somewhere along the line. That is the time which is usually referred to, by those who know little about it, as "them good old days."

After a while, with the mortality running higher than even a New England conscience could stand for, they began using better supports, ladders preferred. A broken board might be inconvenient, but it did not mean a tragedy. Still later, ropes were replaced by wire slings, attached to patent thing-a-ma-jigs which held on like grim death. Instead of having two men on a scaffold untying both ropes at the same time, each trusting implicitly that the other chap would not make a mistake and let go, or tie a slip noose, we now had these new platforms raised by one helper with an iron bar. No matter how he bungled the job, he could not dump the entire outfit onto the sidewalk.

This was the last improvement for many years. A man needed a cool head and an absolute absence of vertigo to handle that kind of job, for one step in the wrong direction left him hanging onto the atmosphere. Then men got scarce for that sort of work, and others had to be broken in. They objected strenuously to standing on a narrow platform, 100 feet above ground, with nothing between them and the cemetery but their ability to stand straight. They wanted safety appliances, and they wanted them quick.

Some builders strung ropes along as a kind of wobbly railing, but this, while much better than nothing, gave none too much confidence to a new man. Likewise, it did not prevent the paint pot, or a loose brush, from falling on some unfortunate pedestrian out for a stroll.

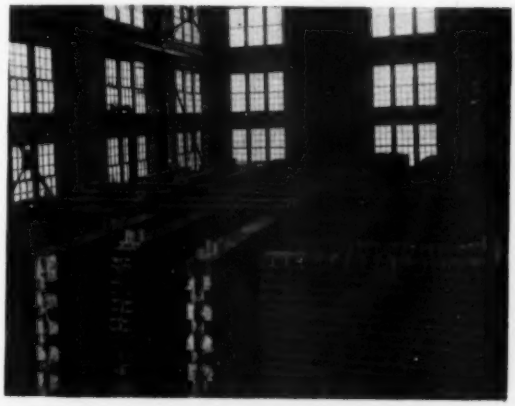
At last some genius, probably a relative of the man who first fixed up his harness—or his Ford—with hay wire, has used a protective system that assures safety to the workman, with peace of mind to the man walking down below. Simple? Of course it is, and it cannot be patented. He has used just plain, ordinary chicken wire, tacked to a board at the upper end and to the platform down below. Can you beat it? —*American Contractor.*

The Strength of Solid and Ideal Brick Walls

Preliminary Report of Tests Made by the U. S. Bureau of Standards

COMMENTING on the tests made by the U. S. Bureau of Standards on solid and Ideal brick walls, A. H. Stang, Assistant Physicist of the Bureau, stated at the 1923 Annual Convention of the Common Brick Manufacturers Association that the prime object of the test was to obtain a comparison between the strength of solid and Ideal brick work as actually built. The same grade of brick was used throughout to obtain a representative grade of work which was comparable to that on an ordinary commercial job. Six reputable firms were invited to submit bids, and the lowest bid was accepted.

A careful record of time and material was kept while the walls were under construction. There was in general a saving of about 30 per cent in the cost of material for the Ideal



BRICK WALLS READY FOR TESTING

AN 8-INCH IDEAL WALL, 6 FEET WIDE AND 9 FEET HIGH, IN A TEN-MILLION-POUND TESTING MACHINE

walls as compared with the solid walls. In the building of the 8-inch solid wall, using lime mortar, 1,586 bricks were laid on an average per day, and 1,110 bricks was the average per day for 8-inch Ideal walls in lime mortar. The area of wall laid was about the same, however, for each type of construction.

The results, quoting from *Brick and Clay Record*, are as follows:

1. About 30 per cent less material was used for the Ideal than for the solid wall.

2. The time required to lay the Ideal was about the same as for the solid walls, therefore the labor cost should be about equal.

3. Compressive tests under central loading of 8-inch walls, both Ideal and solid, showed that they had equal strength whether lime, lime cement, or cement mortar was used.

4. Under central loading, 8-inch walls laid with cement mortar were 24 per cent stronger than if laid with lime cement mortar, and 84 per cent stronger than with lime mortar.

5. When the load was applied with an eccentricity of 2 inches, the 8-inch Ideal walls were 24 per cent stronger than 8-inch solid walls when lime cement mortar was used for both.

6. Twelve-and-a-half-inch solid walls were 50 per cent stronger than Ideal walls Type No. 1, and 87 per cent stronger than Type No. 2 of the same thickness when lime cement mortar was used for all of the walls.

7. When lime cement mortar was used, the 12½-inch solid walls were about 15 per cent stronger than 8-inch solid walls; 12½-inch Ideal Type No. 1 walls were as strong as 8-inch solid walls, which in turn were 64 per cent stronger than the 12½-inch Ideal wall Type No. 2.

Dr. Stang also stated that one side-thrust test was made on one specimen each of Ideal and solid wall 8 inches thick. The panels were 6 feet wide and 9 feet high. Two large timbers were placed against the side of each wall and jacked against the testing machine. Both walls, tested under similar conditions, developed about the same strength.

The construction of Ideal Rolock walls was described in detail in the October, 1921, issue of CONTRACTORS' & ENGINEERS' MONTHLY.

Increased Issue of Building Permits

BUILDING permits issued throughout the United States during the first half of 1923, according to the National Monthly Building Survey prepared by S. W. Straus & Company, New York City, were 36.5 per cent ahead of the same period in 1922. Permits issued in June this year, however, were only 2.3 per cent ahead of the volume issued in June, 1922, and were 10 per cent less than in May of this year. These figures, which indicate a slowing up of building activities as compared with the unprecedented developments of the earlier months of the year, are based on official returns from 229 principal cities and towns.

The eastern states gained 24 per cent for the six months' period, 4.4 per cent over June, 1922, and 5.2 per cent over May, 1923. The central states gained 47 per cent for the half-year period, but June had a loss of 8.7 per cent from June, 1922, and a loss of 27.4 per cent as compared with May this year. The southern states gained 48.5 per cent during the first half of this year, but in June lost 10.3 per cent compared with June, 1922, and declined 24.7 per cent from May this year. The Pacific Coast states gained 52.5 per cent for the first six months of this year. Their permits in June were 32.1 per cent ahead of June, 1922, and 1 per cent ahead of May this year.

The 229 cities reported total building permits for the six months this year of $1,709,425,544, compared to $1,252,580,046 for the first six months of 1922, the gain being $546,845,498. In these cities building permits amounting to $251,527,816 were issued in June this year, which, compared with $245,678,043 for June, 1922, showed a gain of $5,849,773, but showed a loss of $28,832,071 as compared with May.

Manufacturers ---- Distributors ---- Consumers

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Buying Methods of Contractors---Cause and Effect

By W. H. Ziegler

President, Wm. H. Ziegler Co., Inc., Minneapolis, Minn.

IN discussing the buying methods of contractors we will confine this article to that field, although much might be said of similar practises in other lines. Our thought is to present in this article the distributor's view-point, earnestly hoping that it will be thoughtfully regarded and that possibly in these remarks the contractor may see himself as he sometimes appears to the distributor. As expressed by Robert Burns:

"Oh wad some power the giftie gie us
To see oursel's as ithers see us;
It wad frae monie a blunder free us,
And foolish notion."

There are a few right fundamentals customary in buying equipment that are unfortunately disregarded by many contractors in the negotiation and purchase of machinery, with results that are frequently disastrous in the loss of time, money and prestige. On the part of many contractors there is an astounding lack of interest in, and knowledge of, engineering or simple and advanced mechanics, without which they are unable to separate the "chaff" from the "wheat." There is also a lack of realization of what a helpful element the reliable equipment distributor can become in the contractor's work, and a failure to realize the benefits the contractor could enjoy by more consistently supporting his distributor according to his merits.

Many contractors fail to anticipate their requirements and to plan ahead, which results in their being forced many times to pick up undesirable and second-rate equipment on the spur of the moment. Understanding equipment as I do, if I were a contractor it would be my ambition and pride to own standard, finely made units. They appeal to the workman; they do better work; they do it faster with less delay and operating expense, and last longer; greater returns can naturally be expected.

Many contractors attempt to save money by building up "home-made" units, patching here and there, and finally acquiring units of no tangible resale or loan value and a constant source of delays, breakdowns and expenses. Is it not more often the case than otherwise that the contractor with the proper equipment gets not only one job but two or three? Anybody can get one job if he bids low enough. It is equally true that workmen will remain and be more loyal to a contractor who employs equipment of a reliable nature where the machinery is worthy of their time and interest in maintaining it, lubricating it and operating it with a maximum of efficiency and with pride. What workman will give 100 per cent of his energy to a contractor who has machinery that is about ready for the scrap heap? Similarly, poor results are obtained by those who attempt to save money by the purchase of poorly designed, rebuilt or second-hand equipment from irresponsible sources.

Try to select your plants before submitting your bids, so that you will be prepared to place your orders advantageously. Take the engineering element of your distributor's organization into your confidence. Many times he can help you in little suggestions of equipment to save money. Remember that the properly equipped salesman is on hundreds of jobs every week, while you, with your intense interests, are seldom on but two or three in a season, and sometimes less, and that he sees many practical, logical ways and means of performing a piece of work, and his assistance is not to be belittled. A better knowledge of mechanics by the buyer will result in intelligent discrimination and in appreciation of the arguments of the representatives of different machines, instead of the customary question in the midst of a technical explanation—"What is your price?"

Call for bids on equipment the same as you bid on a job, but only to gain a perspective; not necessarily for the purpose of awarding the order to the low bidder, but only for the purpose of judging relative values—then buy the best. It is impossible to compare on an equal standing a bid on a contract job with a bid for machinery. It simply cannot be done. Stone is stone, and sand is sand, and cement can be put in any one of ten ways, but a machine can be built in only one way and that is the right way, so you must know how to pick the right machinery, irrespective of price. It is frequently in evidence that a considerable portion of profit on a contractor's job depends on the judicious buying of equipment, not necessarily meaning

the initial saving, but the saving in the long run.

The question of "trade-ins" has perhaps done more to hurt the contracting industry than any other cause and it directly involves the contractor. If he acquires unstandardized or obsolete equipment, it makes it physically difficult to compete with a contractor owning modern equipment.

We find some manufacturers and some distributors who are selling a "drug on the market" or an article that has not been introduced or is in its experimental stage. Some of these concerns are making exorbitant offers for old machinery on long, ridiculous terms in order to place their machinery in service for the purpose of advertising them. The contractor, handicapped by a lack of knowledge of mechanics, but considering price and terms, thinks he is making a good thing of it, but experience frequently proves the contrary. Buying equipment based on extravagant statements and claims occasionally brought forth in sales literature is not the safe way to buy machinery. Responsible firms will not make such offers nor will they extend any terms that would jeopardize their own or their distributor's finances—they don't have to!

Remember that in buying equipment you should be making an investment and not a speculation, and you should be able to show it on your statement as an asset to your banker and have it accepted as collateral. More study and thought in your buying methods will improve your standing with your banker, and the banker must be educated to the realization that the contractor's plant is worth money. You cannot blame the banker for his present attitude of ignoring most plant equipment as a non-tangible asset. Many contractors' yards look more like junk heaps than well-ordered storerooms.

Place a high value on the strength of the manufacturer behind the product, on the moral support he is reputed to give with his equipment, and the strength and reputation of your distributor. Place a high value on his parts stock, his service and his integrity, for one delay on your job can cause you many times the loss in money of a supposed saving you might effect on the purchase of a lower-priced, less efficient piece of machinery. Remember that "nothing good was ever made but that someone else could make it worse and sell it for less."

In closing this article, the message that we wish to leave is—get acquainted with your distributor; know him better. He wants to work hand in hand with you if he is the right kind, and he will if you will give him half a chance. Do not forget that the distributor is beset with troubles, losses and difficulties the same as you are in your business. Help him to serve you better by helping him grow, because his strength can be used to your benefit. This is the only way to amalgamate the joint interests of the distributor and the contractor and make the broad field of contracting more profitable and safe, and establish it firmly as a consistently safe business rather than as a series of speculative ventures.

"Introducing the Subject of Overhead"

A building contractor was Jimmy O'Toole;
On skinning a job he was nobody's fool,
Till architects wise got to watching him close;
Six sacks to the yard was to poor Jimmy a dose.

But it made Jim some money, he started to grow;
He opened an office and made a fine show.
A warehouse he built, and housed his fine tools,
And took on some help to figure some schools.

He got one, then another, and soon he had three,
And private work, too, he tackled with glee.
He got most of the jobs about twenty per cent low,
But figured the other boobs didn't quite know.

His costs appeared fair, so he felt pretty good.
On a five per cent margin he thought that he should
End the year with a wad of the glittering kale,
Then go after the big stuff; he sure was a whale.

When he came to check up and deducted expense,
"Holy Smoke! I've made less than my bricklayer gents."
So he figured and checked up to ascertain why
With all this fine work he couldn't get by.

The answer? You've got it. O'Toole later said,
"What a fool was O'Toole to neglect Overhead."

His next job, two months later, was one per cent low,
The why and the whereof you probably know,
Jim had figured that five per cent wasn't quite fair
To cover his Overhead and leave anything there.

—*The Earth Mover.*

How to Grow

A man should never be ashamed to own that he has been in the wrong; it is but saying in other words that he is wiser to-day than he was yesterday.

—William Penn.

An Up-to-Date Sand and Gravel Plant

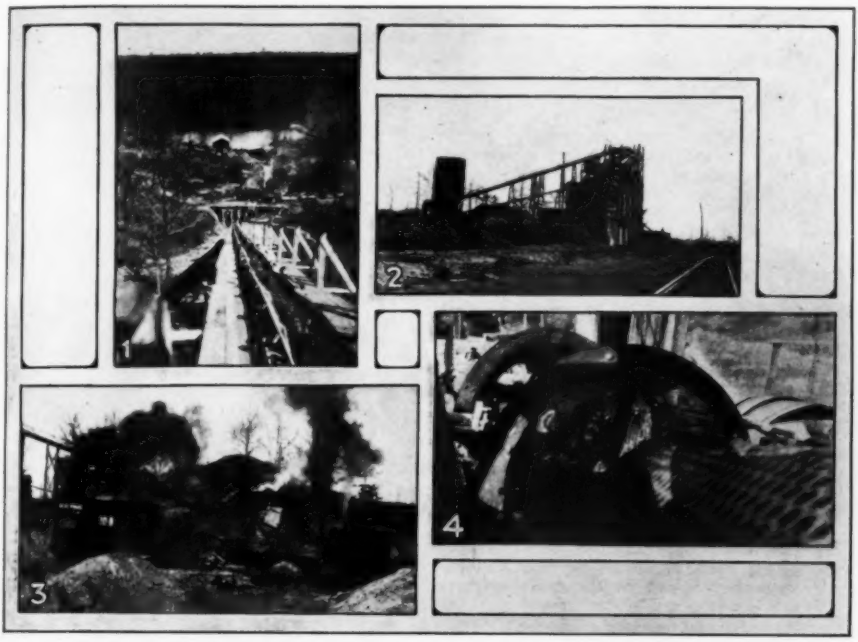
The Spruce Pine Sand and Gravel Company's Plant at Spruce Pine, Ala., Has Unusually Interesting Features

SPRUCE PINE is situated in Franklin County, northern Alabama, about 25 miles due south from Sheffield and Muscle Shoals, on the Tennessee River. It is here that the sand and gravel company which bears the name of the town has opened up one of the most interesting deposits in Alabama and built a plant which is strictly modern in every respect.

The property, which covers 400 acres, contains a sufficient deposit of the best quality of sand and gravel to last the consumer for more than 250 years at the present rate of consumption. The geological formation is remarkable and has puzzled many geologists. The deposit is the highest point in the state and has apparently been forced up by a movement of the earth in some remote period. The plant is on the crest of a ridge which drops down steeply into a valley, where a pond for water-supply has been provided. The mining operations are under way on the slope of the hill.

For purposes of development, the deposit is an ideal one. There is no overburden to worry about and to eat up profits. The water-supply is unlimited, and the plant is alongside the tracks of the Northern Alabama Railway, with easy access to Memphis, Birmingham, Chattanooga, and other big centers.

In addition to the enormous deposit of sand and gravel, there is a remarkable deposit of clay of unusual quality underlying the gravel, which is soon to be developed for face brick manufacture. This clay lies in a thick stratum, which, in many cases, takes on patriotic hues of red, white, and blue. The property also is endowed with a considerable deposit of iron ore, of which the company has worked and shipped upwards of 1,000 cars.



VIEWS OF THE SPRUCE PINE SAND AND GRAVEL COMPANY PLANT AT SPRUCE PINE, ALA.

1. Looking down the conveyor belt from the top of the plant. 2. A general view of the plant. 3. Bucyrus 30-B shovel loading dump-cars which convey material to the grizzly, from which it is fed onto the conveyor belt shown in 1. 4. Looking down the three conical screens

Pit Operation

The sand and gravel company is using two Bucyrus revolving shovels in its pits. An 18-B, with 26-foot boom, 18-foot handle, and ¾-

yard dipper, is working in the sand deposit. Its high reach, afforded by the extra long boom, is serving to good purpose against the high face, which runs up to 40 feet. In order to prevent a cave-in on the shovel, the face is drilled with hand augers and shot down with Dumorite in front of the shovel. This shovel is served by 5-yard Western dump-cars and an 18-ton Vulcan dinkey.

A 30-B Bucyrus shovel of more recent design is working in the gravel deposit against a hard gravel bank. This shovel carries a 20-foot boom, 14-foot handle, and 1-yard dipper.

The Plant

The material is dumped from the cars onto a grizzly, which feeds through a hopper onto a 24-inch conveyor belt with 375-foot centers. This carries the material up the hill to the plant, 65 feet above. The gravel is run through a hopper into a set of three conical Link-Belt 63 x 31½ x 84-inch revolving screens. The first screen is 1½-inch round mesh, and passes gravel ranging approximately from ¼- to 1¼-inches. The oversize is delivered to a bin and sold as railroad ballast. The second screen has a ½-inch mesh and receives the material passed by the first screen, delivering the oversize, or ½-inch to 1¼-inch, to the concrete gravel bin. The third screen has 3/16-inch slotted mesh, the oversize from which measures from 3/16-inch to ½-inch in size, and is sold principally as roofing gravel. The material that is passed by this screen goes over a flat screen with ⅛-inch perforations, where building or engine sand falls into a 72-inch sand separator. The coarse or concrete sand goes to another 72-inch sand separator.

In each one of these screens the material is thoroughly sprayed. One pipe through the center of the screen and one outside keep the perforations clear. The wash from these screens and from the sand separators is delivered through a trough to a settling-tank designed by W. A. Collins, General Manager of the company. This tank saves an asphalt sand of good quality and unusual fineness. The tank, or basin, interrupts the flow of the wash sufficiently to allow the sand to settle. The bins under the 1½-inch and ½-inch screens contain chutes or by-passes which permit the mixing of the two largest sizes of this as specified by the purchaser. The gravel is given another washing just as it is being fed into the car by means of a spray at the delivery chute. When washed, all this material has a uniform whiteness of color.

Water, as has been stated, is obtained from an artificial lake in the valley. It is pumped up the hill to the plant by a 50-horse-power oil engine built by the Bessemer Gas Engine Company, Grove City, Pa. The plant itself is operated by a duplicate of this engine. The manager is enthusiastic as to the service these engines have given, stating that they have cost him practically nothing in repairs since they were installed about 34 months ago. The engines burn crude oil, which is purchased at 6 cents a gallon. The plant is rarely taxed to its capacity, because of difficulty in obtaining cars, but with fair car service, 20 50-ton cars can be shipped in a day.

The officers of the company are John R. Collins, President; A. Philbrick, Vice-President; and W. H. Collins, Secretary and Treasurer and General Manager. A. G. DeArmen is foreman in charge of the plant operations, and John Barrett operated the shovels.

ACKNOWLEDGMENT.—Article by courtesy of *The Excavating Engineer*; illustrations by kindness of W. H. Collins.

Removing a Ten-Story Hill

By Norman C. McLoud

THE destruction of the famous Battery Park Hill, at Asheville, N. C., now in progress, is one of the most interesting dirt-moving jobs now under way in the United States.

In the removal of elevations in the building of Seattle, the topography and environment made it possible for hydraulic streams to be utilized. In the case of the Battery Park undertaking no such simple method was available, because the hill is in the center of a growing city, with no river at hand to serve as a sluiceway, as was true of Seattle. For this reason the removal of the earth and stone must be accomplished by means of steam shovels and wagons.

The work is being done by the Excavation Company, Inc., an Asheville corporation controlled by Clyde S. Reed and Julian A. Woodcock. Mr. Reed is President, Mr. Woodcock, Vice-President and Treasurer, and H. M. McDowell, Secretary. The contract was awarded on January 1, 1923, and actual work was started on January 15. The size of the project is such that the contractors estimate its completion will occupy 500 working days from the date of letting the contract.

The total amount of excavation estimated by the engineers of the contracting firm is 550,000 cubic yards of dirt and stone. The waste material is serving a double purpose, in that it is being used to fill a ravine on either side of Coxe Street, a new thoroughfare recently opened to connect Patton Avenue with Southside Avenue. This involves hauling the waste for distances ranging from 2,500 to 3,000 feet.

For the excavation the contractors are now using one Bucyrus steam shovel and one Erie steam shovel, moving about 500 yards per day by each shovel. This equipment will be increased by the addition of two more Bucyrus shovels which will be placed in action about September 1, near the close of the summer season of the famous Battery Park Hotel, which

now occupies the summit of the hill. Work on the tearing down of the hotel will begin October 15. With the added shovels, the contractors expect to move about 2,000 cubic yards per day.

The equipment used in hauling the waste material is composed of dump-wagons, and the rate of removal is placed at an average of approximately 1,000 loads a day. The number of men employed at present is about 75, but this will be largely increased when the additional steam shovels are placed in commission in the autumn.

The cost of the undertaking is estimated by the contractors at $275,000.

Mr. Grove bought the famous Battery Park hill from the estate of Colonel Frank Coxe, who was a member of the Coxe Brothers Company, extensive operators in the anthracite coal fields. His purchase was attended by a vision of utilizing valuable real estate in the heart of Asheville which had previously served no other purpose than to afford a beautiful park for the immediate surroundings of the old hotel. The slopes of the hill were too steep to make them available for development through the opening of streets, and on this account the business section of the rapidly growing city of 50,000 inhabitants has grown up around the hill, leaving a valuable area undeveloped and unproductive. With the increasing growth of the city and the augmented value of the idle land, Mr. Grove conceived the reduction of the hill for the accommodation of its grades to street construction. By putting this conception into execution he is making an important contribution to the community, as his operations will open up about ten acres of land for utilization as high-class and centrally located business property. The leveling process will lower the crest of the hill to an extent which will cause the roof garden of the new ten-story structure to come at about the present ground level.

Prices of Building Materials in the Northwest

As Reported by the Division of Building and Housing, Bureau of Standards

A TABLE issued by the Division of Building and Housing, Bureau of Standards, Washington, shows the average prices paid by contractors for building materials delivered on the job early in April in northwestern cities.

Commodity, Size or Condition	Unit	Grand Forks	Sioux Falls	Waterloo	Council Bluffs
Common brick	1,000	15.00	18.00	14.80	16.50
Portland cement, excl. of containers	Bbls	3.80	....	3.00	3.10
Yellow pine No. 1, dimension 2x4-16' SISIE	M	....	....	48.00	50.00
Douglas fir No. 1, dimension 2x4-16' SISIE	M	52.00	51.50	46.00	48.00
N. Carolina pine No. 1, dimension 2x4-16' SISIE	M	....	....	....	....
Common boards, No. 1, 1x6	M	50.00	46.00	44.00	50.00
Y. P. flooring edge grain "C", 1x4-10'-16'	M	....	95.00	95.00	105.00
Douglas fir V. G. No. 2, 1x4-10'-16'	M	95.00	83.00	95.00	....
Red cedar shingles, extra clear 16" 5 to 2	100 sq. ft	6.00	5.60	6.50	6.80
Cypress shingles, extra clear 16" 5 to 2	100 sq. ft	....	....	....	....
Composition shingles, crushed slate surfaced	100 sq. ft	8.00	7.50	7.50	8.00
Gypsum plaster board, ⅜"	1,000 sq. ft	65.00	35.00	....	....
Lime, HYD. Com	Ton	28.00	24.00	20.00	18.00
Building sand	Cu. yd	2.70	1.25	1.50	3.50
Crushed stone, ¾"	Ton	....	....	3.00	4.00
Wire nails	Keg	5.40	5.00	5.40	4.75
Window glass, single A-10"x12"	50 sq. ft	....	5.40	5.25	....
Hollow tile, 8"x12"x12"	Each	....	.19	.17	.14
Cast iron soil pipe, 4" E. H., 13 lbs. per ft	Ton	90.00	....	80.18	....
Steel pipe, 1" galv	100 ft	10.50	....	10.00	....
Reinforcement bars, ¾" square	100 lbs	5.70	....	3.80	3.50
Structural steel, fab. 6" I-beams	100 lbs	5.70	....	4.95	4.70
White lead, dry	100 lbs	13.75	14.75	14.00	14.25
Zinc oxide, Am. process lead free	100 lbs	....	....	19.00	18.00
Gypsum plaster, neat	Ton	27.00	....	18.00	18.00
Linseed oil, raw in bbls	Gal	1.60	1.27	1.30	1.34
Roofing slate, No. 1 ribbon	100 sq. ft	....	....	18.00	....
Tarpaper, roofing, 2-ply, 75 lbs. per roll of	100 sq. ft	3.00	2.70	3.25	3.15
Rosin sized sheathing, 3-ply, 30 lbs. per roll of	500 sq. ft	1.75	1.30	1.50	1.35

From *The Improvement Bulletin*.

Improvement in Wood Block Specifications

TWO new sections have been added to the specifications for wood block street paving and flooring which for some time have been before the American Wood Preservers' Association. The specifications have been adopted as standard. Bituminous mastic cushion, consisting of 10 per cent of bitumen, either coal tar or asphaltic oil, and 90 per cent of clean dry, screened sand, may be used instead of a cement-mortar cushion. To permit the mastic to cure, it is to be spread a day in advance of laying the blocks. A maintenance clause calls for inspection each summer and a surface treatment of light tar (¼- to 1/3-gallon) and sand when the pavement shows signs of shrinkage or open joints.

First Concrete Street Contract Completed in Boston

Pavement on Commonwealth Avenue Constructed by A. G. Tomasello & Son Is First in History of the City Built by Contract

WITH Mayor Curley and Messrs. Shea, Long and Murphy of the Boston Park Commission present, the new concrete pavement on Commonwealth Avenue between Warren Street and Sutherland Road was officially opened to traffic on July 7. This stretch of paving, serving practically all through-traffic between Boston and western Massachusetts, marks a new departure in the development of paving in Boston, in that it is the first piece of reinforced concrete street paving ever placed under contract by the city. Two other stretches of concrete pavement were laid by the Public Works Department with its forces several years ago before concrete pavement had reached its present high state of development.

The paving of Commonwealth Avenue was the result of careful study by the Park Commission engineers and follows the most modern practise of highway experts. The pavement consists of four parallel strips of concrete, reinforced with ½-inch steel bars, both longitudinally and laterally. The transverse joints are filled with special material designed to exclude moisture and at the same time permit the expansion and contraction of the concrete without damage to the pavement. All the sections of the pavement are doweled together with ¼-inch steel rods, in order to prevent unevenness in the surface due to unequal settlement. The surface is heavily scored by the use of a street broom in order to afford a secure grip for the wheels of traffic in any sort of weather.

The concrete pavement is 3,500 feet in length, 50 feet in width, including granite block gutters, and 4 feet in width on each side of the road. The concrete is 7 inches thick. The cost of the concrete pavement, including the steel reinforcement, is $3.20 per square yard. The total amount of concrete laid was 16,000 square yards. The total cost of the improvement was $70,000, which includes the concrete pavement, grouted granite block gutters, the removal of extreme crown of the existing road, and regrading approaches to the new concrete road.

The Park Department was confronted with the problem of cutting down the height of the crown to make the pavement more suitable for modern traffic. This was accomplished under the contract and the crown of the road reduced from 20 inches to 8 inches. The necessity of constant repair to any but permanent types of pavement would have been a continual drain on the resources of the department. The hilly nature of the avenue made it necessary to lay some type of pavement with sufficient frictional resistance to afford security to all types of traffic. The concrete for the construction of the pavement was awarded to A. G. Tomasello & Son, of Boston, who have constructed many fine stretches of pavement in eastern Massachusetts. The designs were made and carried out under the supervision of J. J. Murphy, Engineer of the Board.

Before selecting a concrete pavement for Commonwealth Avenue, the Park Commission investigated the practise of other cities and towns in the eastern part of the country, and found it to be a popular type with public officials and engineers and taxpayers. The report of the engineers on the Bates Experimental Road, described in the June issue of CONTRACTORS' & ENGINEERS' MONTHLY, was studied, and it was found that of the 63 different sections of pavement tested by that body only 4½ per cent of the brick and 17⅞ per cent of the asphalt sections successfully sustained all imposed traffic, while 41.67 per cent of the concrete seections were a complete success.

The contract was let on April 26, 1923, and four of the five bidders were members of the New England Road Builders Association, according to *The Nerba*. The bidding was so close that only $15 separated A. G. Tomasello & Son and the Rowe Contracting Company, the first and second bidders, respectively, on this paving job.

Why Does Concrete Crack?

Statement Prepared for the American Chemical Society Contains Interesting Information

THE problem of cracking concrete is one which engineers "ought to look squarely in the face and not theorize about," according to Maximilian Toch, a New York manufacturer, in a statement on the protection of concrete and other building materials against water and noxious fumes. Steel, concrete, wood and brick are the principal building materials used in factories, but in residences, office buildings and warehouses, stone, plaster and oxychloride compositions are also used, and if surface area is taken into consideration, probably concrete is more largely used than all the others combined.

The first fact with regard to untreated concrete which strikes us most forcibly is that

up to 1914 the United States Navy did not have a single great dry dock in good condition, but, particularly, the Brooklyn dry docks had to be continually patched and repaired where they had cracked abnormally or where the sea had leached them badly. The five gigantic dry docks built by the Navy in Norfolk, Philadelphia and New York since 1912 have all been waterproofed by the integral method, and sufficient time has passed, particularly in the case of the No. 4 dry dock of the Brooklyn Navy Yard, which is over nine years old, to indicate that no deterioration or solution of mortar or concrete has taken place.

Sidewalks made of concrete do not receive any treatment either by the integral or by the surface method, and as a rule they show up very well. This is probably due to the fact that sanding, dusting and abrasion of the sidewalk are not noticeable.

In this climate, where the temperature variation approaches 130 degrees or more, concrete roads are liable to crack badly and must be filled up with a bituminous or elastic material. Before they are repaired, frost is likely to enter, and then the fissures widen. Some engineers maintain that concrete needs no integral or surface treatment whatever, if additional portland cement is added and if the workmanship is proper, but this statement is only partly true, according to Mr. Toch.

In the first place, there is a question whether exact supervision can be had in large construction work, and, of much greater importance, there is the problem of chuting. Chuting saves time and labor, but sometimes in very large operations 20 tons of concrete are loaded on a car propelled anywhere from 100 to 1,000 feet and the contents are lifted into a chute and allowed to slide into place. Unless an integral material that acts as a lubricator and that slightly retards is used, bad concrete is liable to result and clogging may take place. But when no proper integral material is used, the slide is wet and water is added to the concrete to make it slide. Too much water in concrete is fatal. For example, in a very large Government building in Washington, in which the closest supervision was had over the concrete work, the addition of too much water in the concrete of which the floors are made resulted in one of the worst cases of cracking that have ever been seen; in fact, every floor in that gigantic building is alligatored to a tremendous extent.

According to Mr. Toch, engineers ought to look this problem squarely in the face and not theorize about how it might be done without the addition of some protective material. He states that you cannot build a concrete bin or building in which certain chemicals are stored unless the concrete is acid-proofed, either integrally or by means of a thorough surface application, and you cannot dustproof and harden a cement floor, no matter what formula of cement, sand and aggregate you devise, unless a suitable material is applied to the surface.

Preparing Plans and Specifications for Excavations

IN preparing plans and specifications for large excavation work to be done by contract it is best to divide the work into contracts of such size as to attract the maximum number of bidders who will do the work themselves rather than to have a contract so large that very few contractors are in a position to bid.

An example of this situation was afforded on the New York State Barge Canal when it was under construction. A large contract on which the engineer's estimate was about $4,000,000 was advertised twice, only two bids being received at figures very materially above the estimate. The work was then cut into four contracts at about a million dollars each and readvertised. There were several bidders for each contract and the whole work was let considerably under the estimate.

It is well also to consider the type of machine which can be used to best advantage on the different sections of the work, and endeavor to let the contract so that a contractor who specializes in one type of machine may bid on a contract almost entirely involving work with his type of machine. As a rule, a contractor who owns and works dragline machines will not have the intimate knowledge necessary to make a close bid on work requiring a hydraulic dredge, and one who has grown up with the steam shovel will not venture into bidding on a piece of work which can be done best with a dipper dredge without adding a considerable amount for contingencies. If the work can be divided so that the hydraulic dredge man will have to consider hydraulic dredge work only, the lowest bid should be received from him for that section.

Points for Estimators

In making up estimates for excavating, the following points must be carefully taken into consideration:

Plant required
Transportation and erection
Fuel
Transportation of fuel
Water
Transportation of water
Labor
Transportation of labor
Living quarters
Camp supplies
Transportation of camp supplies
Cooking and care of camp
Repairs to machinery
Transportation of repair parts
Interest on investment
Depreciation
Insurance on the plant
Liability insurance
Bonds
Interest on deferred payments
Lay-up of plant for winter
Superintendence
Engineering
Time-keeping
Watchmen
Office
Traveling
Sickness

Concrete Bridge Constructed with the Future in Mind

New Bridge at Sioux City, Iowa, Built for Future Development and at a 40 Per Cent Saving in Cost by Using Slabs and Piers in Place of Arch

By John D. Adams
Sioux City, Iowa

THE outstanding features of the new concrete bridge over the Sioux River, connecting Sioux City, Iowa, with South Dakota, are the provisions which have been made for the future and the saving of about $40,000, or approximately 40 per cent, by adoption of a suitable type of slab and pier bridge in preference to the arch type now quite generally used for its artistic appearance. The bridge replaces an old steel and wood bridge erected nearly 50 years ago and long since condemned as not safe. Low banks on either side of the river and soft soil on the Dakota side led to the adoption of the slab and pier type of bridge.

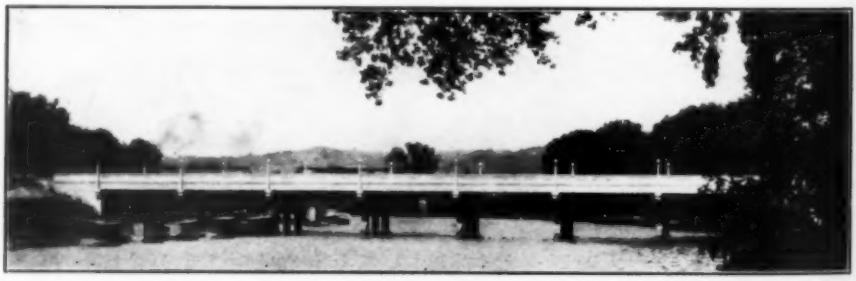
The bridge has a total length of 326 feet, exclusive of the wings at both ends. There is a 30-foot roadway with two sidewalks of 6 feet each on either side of the road. There are 18 concrete electroliers, 9 on each side, spaced 42 feet apart.

The structure was designed to carry an 80,000-pound interurban car, which is one of the heaviest now in use. Although there are no electric lines running across the bridge at present, it was seen that this would be necessary within a short time. To provide for the future use of the bridge by cars, ties were embedded in the concrete in the proper location and then covered. The floor on either side of the track site is designed to carry 40-ton loads. This precaution of providing for future tracks is one too often neglected because of the slight increase in cost.

The foundation of the bridge consists of clusters of piling 30 feet long below the bed of the stream. They are arranged in threes under each span support, and are themselves 42 feet apart. Each cluster of piling is encased at the top with reinforced concrete and a 6-foot steel cylinder having a diameter of 8 feet. Immediately above this there is a convergence of reinforced concrete to the column up through the water to the large transverse beam which supports the floor system on either side.

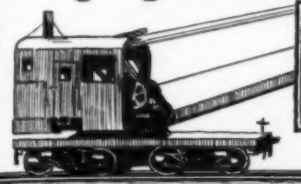
The floor system consists of eight large beams 3 feet deep below the floor, running lengthwise and bearing on the main transverse beams through copper and lead plates. The plates give a nearly frictionless bearing surface to take care of the expansion and contraction in the length of the bridge. The floor is 8 inches thick, and reinforced heavily both top and bottom. The sidewalks are 5 inches thick and the hand-rails are 3 feet high with spindles and openings in the panels.

In proportioning the cost, Sioux City, Iowa, paid two-thirds, and Union County, S. Dak., paid the other third. The total cost was $63,-015. L. N. Hintgen, City Engineer of Sioux City, who supervised the construction of the work, believes that this is the only bridge of this kind that has been built for less than $100,000 in that part of the country. It is the only bridge that has been designed to carry 40-ton loads and that has a 30-foot roadway and a regular street lighting system. The construction of the bridge was begun in August, 1922, but material shortages made it impossible to open it until March, 1923. Much of the concrete was poured in cold weather, but the results have been excellent. A total of 1,515 cubic yards of concrete and 260,000 pounds of reinforcing steel was used in the construction of the bridge.



VIEW OF THE WELL-LIGHTED CONCRETE BRIDGE AT SIOUX CITY, IOWA

Equipment for Contractors



The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

MORE ECONOMICAL REINFORCED CONCRETE
The Truscon Steel Co., Youngstown, Ohio, in a series of well-illustrated descriptive booklets, gives complete information regarding Truscon-I construction for builders, which combines all of the advantages of reinforced concrete and of structural steel at a great reduction in cost of labor and materials.

VERSATILE TRACTION STEAM SHOVEL
The Keystone, a versatile traction steam shovel with the efficiency of specialized design and usable with three different interchangeable scoops, skimmer, ditcher and clam-shell, for all grading, trenching, back-filling, cellar digging, loading and handling materials, is described in detail in the literature of the Keystone Driller Co., Beaver Falls, Pa.

ASPHALT HEATER FOR ROAD WORK
The Kinney Mfg. Co., 3529 Washington St., Boston, Mass., in its literature, describes the Kinney auto heater and distributor for applying hot and cold bituminous material to roads under pressure.

INDUSTRIAL RAILWAY EQUIPMENT
Industrial railway equipment, including portable track switches, road builders' trucks and batch boxes and contractors' square box dump-cars, are described in detail in the bulletins of the Koppel Industrial Car & Equipment Co., Koppel, Pa.

GATE-VALVES
The illustrated catalog of the Ludlow Valve Mfg. Co., Troy, N. Y., describes in detail Ludlow gate-valves for water, steam, gas and oil, either hydraulically or electrically operated.

STREET FLUSHERS AND SPRINKLERS
The literature of the Municipal Supply Co., South Bend, Ind., describes South Bend, "Studebaker Model," street flushers and sprinklers for removing or laying the dust of city streets.

CLEANING WATER-MAINS
The National Water Main Cleaning Co., Hudson Terminal Building, New York City, can show you how to clean water-mains quickly and cheaply. Send for its interesting illustrated literature, which shows how many cities have saved the cost of installing new mains by cleaning the old ones.

EXPANSION JOINTS FOR MONOLITHIC ROADS
Pioneer expansion joints, which are placed in monolithic pavements to take care of expansion and contraction and which are produced from a pure asphalt, are described in detail in the literature of the Pioneer Asphalt Co., Lawrenceville, Ill.

WATER-WASTE SURVEYS
Pitometer surveys, which have found leaks and stopped water waste in many cities throughout this country, are described by word and picture in the literature of the Pitometer Co., 52 Church St., New York City.

WATER-METERS FOR EVERY SERVICE
Water-meters for every class of service, as well as meters for gas, oil, air, gasoline, hydrogen, acetylene and other fluids, are described in the literature of the Pittsburgh Meter Co., East Pittsburgh, Pa.

CONTRACTORS' KEROSENE LANTERNS
Lanterns with perfected ventilation and outside wick raisers and other special features of advantage to contractors are described in detail in Bulletin B-30, issued by the Adams & Westlake Co., Chicago, Ill.

DOUBLE DRAINAGE TRAP AND DRAIN
The Josam double drainage urinal trap and drain with adjustable eccentric bushings solves the problem in meeting distortions or irregularities in receptors when they will not coincide with "roughed-in" connections. Catalog F, describing this trap, as well as the complete Josam line, may be secured from the Josam Mfg. Co., Canal Road and L. E. & W. R. R., Michigan City, Ind.

CHLORINATION FOR WATER-SUPPLIES
The literature of Wallace & Tiernan Co., Inc., Newark, N. J., tells what chlorination has done in decreasing the incidence of water-borne typhoid fever.

SCARIFYING ROADS PROPERLY
The Universal Road Machinery Co., Kingston, N. Y., in its 8-page illustrated booklet K-119, describes the usefulness of the Porcupine scarifier, which will operate in either direction, can ream close to the curb and follows a straight line readily in scarifying the surface of old roads, preparatory to resurfacing.

WHAT TRACTORS ARE DOING
If you are interested in what tractors have done, are doing, and can do, write to the C. L. Best Tractor Co., San Leandro, Calif., and ask to be put on the mailing list for "Best Tractor News," an interesting sheet published by this well-known tractor company.

A HAND HOIST FOR DUMP BODIES
An efficient, well-designed and well-built hand hoist for motor truck dump bodies up to 3½ tons capacity, which sells at a moderate price, is described in detail in the literature of the Rock Manufacturing Co., Waterloo, N. Y.

THE ECONOMY OF TRUCK LOADERS
In Catalog 523, the Haiss Manufacturing Co., Inc., 143rd St. and Rider Ave., New York City, tells an interesting story of the economy of Haiss heavy duty path-digging truck loaders for loading crushed stone, sand, gravel, crushed slag, earth and other loose materials.

A RECOMMENDED BUILDING CODE
Building contractors and engineers interested in securing a well-prepared building code for cities with populations from 25,000 to 150,000 should write to H. Colin Campbell, Portland Cement Association, 111 West Washington St., Chicago, Ill., for the Association's latest recommended building code. This Association has also issued a recommended code for cities from 5,000 to 25,000.

AN ENGINE BUILT FOR HARD USE
The Hercules Corp., Engine Div., Dept. C, Evansville, Ind., in its latest literature tells why the Hercules is an engine which a contractor can put on a job without having to coddle or coax it, also why it is a particularly economical power plant.

STRONG POINTS IN WHEELBARROWS
No matter what you use a wheelbarrow for, you will find one specially built for that service listed in the catalog of the Sterling Wheelbarrow Co., Milwaukee, Wis., makers of better wheelbarrows without weak spots.

STEEL CHUTING PLANTS FOR CONCRETE
The latest improvements in steel chuting plant equipment found in the Ransome heavy steel tower, are described in detail in the latest literature of the Ransome Concrete Machinery Co., 1750 Second St., Dunellen, N. J.

TRACTORS EQUAL TO EVERY EMERGENCY
The Holt Mfg. Co., Inc., Peoria, Ill., claims that the Holt Caterpillar tractor is equal to every emergency and that severe operating conditions emphasize the difference between the Caterpillar tractor and every other machine or method for handling road machinery and other heavy haulage problems. The literature of this company tells the story.

LARGE CAPACITY GASOLINE SHOVELS
The reason for the tremendous power and capacity of P. & H. gasoline or electric shovels is in the powerful crowding motion, which forces the dipper to bite into the hardest soils or rocks. This is described in the literature of the Excavating Machinery Div., Pawling & Harnischfeger Co., 3819 National Ave., Milwaukee, Wis.

LONG-LIVED CULVERTS
Newport rust-resisting culverts are described in detail in a free booklet, which also records the complete chemical tests of the materials in these half-round and full-circle types of corrugated culverts. Get your copy of this booklet from the Newport Culvert Co., 542 West 10th St., Newport, Ky.

DO YOU NEED A ROAD ROLLER?
No matter what your road roller requirements may be, you can find just the type of road roller that you need listed in Catalog A of the Buffalo-Springfield Roller Co., Springfield, Ohio.

PROTECTING MODERN PAVEMENTS
The need of expansion joints in concrete, brick and other block type pavements is well known. The literature of the Waring-Underwood Co., Commercial Trust Building, Philadelphia, Pa., describes the special protection which may be secured by the use of Ideal expansion joints.

BETTER ENGINES FOR CRANES AND SHOVELS
Your cranes, excavators and shovels should be equipped with the best engine possible to place them on the earning side of the ledger. Write to the Climax Engineering Co., 1 West 18th Ave., Clinton, Iowa, for the catalog of the Climax engine, which never lacks power on any job.

CALCIUM CHLORIDE AS A DUST LAYER
The new Solvay Road Booklet issued by Semet-Solvay Company, Department L, Syracuse, N. Y., describes Solvay calcium chloride, which has no odor, does not track or discolorize and is a clean chemical salt adapted to dust laying, binding the surface, and killing the weeds.

REDUCING ROAD MAINTENANCE
If the next contract you secure requires a maintenance guarantee, get a copy of the Stanolind booklet issued by the Standard Oil Co. of Indiana, 904 S. Michigan Ave., Chicago, Ill., describing the latest methods of constructing and maintaining bituminous pavements, which will enable you to produce a pavement with Stanolind paving asphalt which will last many years without repairs.

FIGHTING THE SNOW ON HIGHWAYS
Are your trucks and tractors equipped with snow plows to open up the highways to and from your jobs next winter? The complete Champion snow plow catalog, which may be secured without charge from the Good Roads Machinery Co., Inc., Kennett Square, Pa., tells many interesting stories of the use of these plows by cities and contractors.

ROAD ROLLERS THAT LAST
If you have had experience with road rollers that go to pieces after the first one or two construction seasons, get the illustrated literature of the Erie Machine Shops, Erie, Pa., describing Erie tandem paving rollers, which are guaranteed against breakage or wear for five years and which last for decades.

MIXERS THAT STAND THE STRAIN
Concrete mixers are subjected to all kinds of strains when moving and when under operation. Write to the Koehring Company, Milwaukee, Wis., and ask for details of Koehring heavy duty construction, which makes these mixers stand up under the hardest usage.

TRENCH EXCAVATORS THAT SAVE MONEY
The reason why one contractor has owned seven Buckeye excavators is told in an interesting manner in the illustrated literature of the Buckeye Traction Ditcher Co., Findlay, Ohio.

BARROWS FOR EVERY JOB
The Puffer-Hubbard Mfg. Co., Minneapolis, Minn., will furnish complete information regarding its full line of low-priced wheelbarrows, which are built specially for the particular job they are to handle.

A 10-GALLON HEATING KETTLE
The literature of Connery & Co., Inc., 4000 N. Second St., Philadelphia, Pa., describes in detail the 10-gallon tar and asphalt kettle made by this company and said to be ideal for road contractors and small patch work. This company also makes kettles from 10 to 1,000 gallons capacity in 20 different styles.

WATER-WORKS SPECIALTIES
Catalog No. 20, issued by H. W. Clark Co., Mattoon, Ill., describes Clark water-works specialties, including valve boxes, pipe pushers, service boxes, valve housings, pipe test plugs, special castings, pipe jointers and cutters.

LOWER YOUR CONCRETE MIXER UPKEEP
The catalog of the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio, describes the 18 models of Jaeger mixers, which have fewer parts, less wear, lower upkeep and longer life.

SAVE TIME IN CURING CONCRETE
"How to Cure Concrete," a book that is full of ideas and suggestions for a man who would become familar with the proper handling of Dowflake calcium chloride in speeding up the curing of concrete, may be secured from the Dow Chemical Co., Midland, Mich., U. S. A., without charge, by mentioning CONTRACTORS' & ENGINEERS' MONTHLY.

HOW TO DRIVE CONCRETE PILES
Bulletin 31, issued by McKiernan-Terry Drill Co., 19 Park Row, New York City, describes the McKiernan-Terry double-acting steam pile hammers, which are entirely controlled by the throttle on the steam line.

MOTOR TRUCKS BUILT FOR CONTRACTORS
The Garford Motor Truck Co., Lima, Ohio, will be pleased to send to contractors complete information regarding the compact, flexible, full-powered trucks which it manufactures and which have shown ability to get in and out of tight places.

TRUCKS WITH MINIMUM DEPRECIATION
The reason why Federal trucks have lower depreciation and how they are built to last longer and operate for less money, is told in Booklet S-23, which may be secured from the Federal Motor Truck Co., Detroit, Mich.

SELF-DUMPING BODIES FOR FORDS
Self-dumping bodies made entirely of steel, operated by gravity, requiring no hoist and sold at a surprisingly low price for mounting on Ford one-ton trucks are described in detail in the latest illustrated descriptive folder of the Wood Hydraulic Hoist and Body Co., 7924 Riopelle St., Detroit, Mich.

TRUCK TIRES THAT CHALLENGE COMPARISON
Semi-pneumatic tires that are made only by the B. F. Goodrich Rubber Co., Akron, Ohio, and which have revised the old standards of what a truck can do, are described in the latest literature of this company, which may be secured free on request.

ASPHALT PAVING TOOLS
Asphalt tampers and smoothers, pouring pots and heaters, of particularly good design and built to last, are described in the complete catalog of Littleford Brothers, 500 East Pearl St., Cincinnati, Ohio.

A REASONABLY PRICED CONCRETE MIXER
Boss mixers from ½- to 5-bag sizes, and the Packard tilting mixer mounted as a trailer for hauling behind automobiles, are described in detail in the literature of the American Cement Machine Co., Inc., Keokuk, Iowa.

WRECKING-BARS
Three styles of wrecking-bars for removing concrete forms, opening crates or wrecking buildings, are described in detail in the literature of Anderson Bros. Mfg. Co., 1911 Kishwaukee St., Rockford, Ill.

STURDY CONCRETE MIXERS
Concrete mixers giving 120 to 150 cubic yards in 10 hours with one-bag machines, and more in proportion in the larger sizes, are described in detail in the literature of the Aflas Engineering Co., 3006 Galena St., Milwaukee, Wis.

SELF-LOADING FOUR-WHEEL SCRAPERS
Contractors can handle their grading without teams if they use Baker Maney self-loading scrapers, which cut the grading gang down to two or three men and make it possible to handle 40 to 50 yards per hour. Catalog No. 96-A issued by the Baker Mfg. Co., 585 Stanford Ave., Springfield, Ill., describes these scrapers in detail.

Efficient Machines on Road Work

MARION STEAM SHOVEL LOADING GMC TRUCK OWNED BY JOHN FLY, CONTRACTOR, ROCHESTER, N. Y.

SMITH PAVER OWNED BY METZEL, O'HEARN, VASTINE & LEWIN COMPANY, OPERATING ON KNOX AND BELLE COUNTY HIGHWAYS, KENTUCKY

This machine, sold by the Brandeis Machinery & Supply Company, Louisville, Ky., has averaged 800 feet of 16-foot concrete base per day, running as high as 1,150 feet under best working conditions

An All-round Model Excavator

Contractors Expect Service, Versatility and Labor-Saving in Excavating Machinery To-day

CONTRACTORS to-day watch the market very closely for machines which can be used in many different types of work. The day of the highly specialized machine in general contracting work has passed and the day of the versatile machine is at hand. The model 6-T excavator placed on the market by the Austin Machinery Corporation, 3500 Dorr Street, Toledo, Ohio, is of the full-circle swinging-boom type, mounted on multi-pedal traction with brakes and clutches for efficient steering. This excavator is constructed for service as a crane, a clam-shell, a shovel, or a skimmer. The same boom is used for the crane or the clam-shell, and special interchangeable booms are required for skimmer and shovel service.

This excavator may be equipped with steam, gasoline or electric power. The upper or rotating frame is composed of a cast steel main member and heavy beams carefully arranged to resist the severe strains to which it is subjected in heavy work. The lower frame is also composed of a cast steel main member and heavy beams capable of standing the same heavy service as the upper frame. The turntable on which the upper body rotates is of the cone roller type.

The boom used for the crane or clam-shell service is made up of structural steel parts. A large-diameter steel sheave is mounted in the peak for carrying a hoisting rope from the bucket to the hoisting drum. The excavator when used for crane service is furnished with a 35-foot boom and a 12-ton, 3-line hook and block, or a 40-foot boom with the same hook and block. For clam-shell bucket service a 45-foot boom is furnished for a 1-yard bucket, and a 55-foot boom for a ¾-yard bucket. The shovel boom is of built-up box girder construction with a built-up section stick of selected fir armored with steel. The rack is a solid casting rigidly riveted in place on the stick. For shovel service a 21-foot boom and a 14-foot dipper stick with a 1⅛-yard dipper are furnished, or a 25-foot boom with a 17-foot, 6-inch dipper stick and a 1-yard dipper. The skimmer boom is also of built-up box girder construction, and the side members form a track or runway for the bucket. The skimmer bucket boom is 25 feet long for the 1-yard bucket, and 30 feet long for the ¾-yard bucket.

Compressed-air-operated clutches and brakes are provided for hoisting, swinging and propelling control. For the boom hoist an oil-immersed, worm-driven, self-locking drive and reserve jaw clutches are provided. All of the machinery is designed for heavy work, the shafts are liberal in size, and the simple arrangement of the machinery gives access to all parts and makes it possible to remove nearly all the shafts without dismantling or removing other parts.

When operated by steam, a duplex non-reversing main engine is used. The engine is self-contained and has a single-casting frame which insures perfect alignment. The non-reversing engine, together with the full reverse control of all machinery, eliminates all doubt about the direction of action following the setting of any clutch.

On the gasoline power machine the engine is of the heavy-duty marine type with a proper size radiator, fan and circulating pump and a large fuel tank. For electric operation, the selection of a motor depends upon local conditions. Due allowance of time should be made for selecting the proper motor, that there may be no delay in setting it.

A 6-T Austin excavator with ¾-yard bucket and 50-foot boom, owned by Sanford and Brooks, Baltimore, Md., is pictured on the front cover of this issue of CONTRACTORS' & ENGINEERS' MONTHLY, engaged in handling material on a road job.

A New-Size Gasoline Shovel

A ONE-YARD capacity shovel, operated either by gas or electricity, has recently been brought out by the Pawling & Harnischfeger Company, Milwaukee, Wis. The new machine is very similar in design to the ½- to ¾-yard machine made by this company. Being driven by gasoline or electric motor, it is operated by one man, with no fireman needed. The saving of this one man's wages alone amounts to an appreciable sum of money.

Another feature of the gasoline or electric drive is the practical elimination of oil- and water-hauling expense. This item is very costly with a steam shovel, often requiring the full time of a man and team. Another advantage is the ease of operation in inaccessible places.

The crowding motion of the one-yard shovel is the standard P & H design. A manganese rack on the dipper stick is driven by a heavy thimble roller chain from a set of planetary gears. These gears are mounted on the forward drum of the machine. This gives a positive crowding motion, regardless of the position of the dipper, and enables the operator to bite into the heaviest digging.

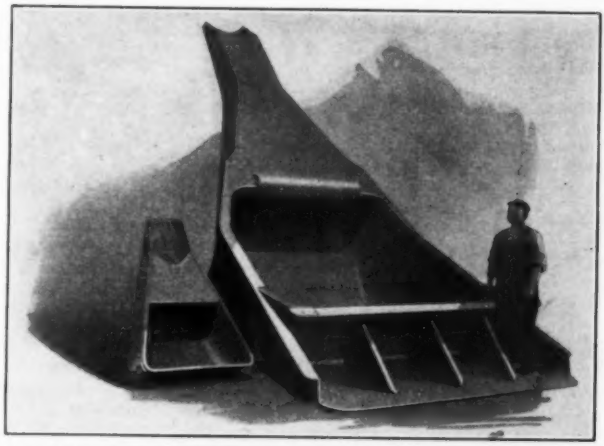
The machine is designed to come within standard railway clearances with only a minimum amount of dismantling. This is a very important feature for machines that have much moving about to do. The shovel is mounted on a corduroy traction which is very rugged, being built entirely of steel, and is claimed by the manufacturers to be non-cloggable even in the heaviest going.

A Whale of a Mixer

New 32-E Paver Lays 4 Lineal Feet of 18-Foot Road, 7 Inches Thick, from One Batch

A FEW years ago a contractor would have been thought out of his senses if he had asked a manufacturer for a concrete mixer that would handle 32 cubic feet of mixed concrete in one batch — sufficient to lay 4 lineal feet of road 7 inches thick and 18 feet wide.

The Koehring Company, Milwaukee, Wis., has designed and built this new 32-E paver for the bigger jobs where adequate supplies of materials necessary to feed it continuously are available. A complete batch of 56 cubic feet of aggregate is handled from one truck or batch box. One man controls all the operations of charging, mixing and placing the concrete, with an additional man for operating the derrick when used.



A COMPARISON OF THE SKIPS OF A SMALL DANDIE MIXER AND OF A NEW 32-E MIXER

The charging skip, 9 to 12 feet wide and 20 feet long, is of ample size for a truck with a full-batch capacity to back into it and discharge its load. When using the industrial system, a power-operated derrick with power hoist and power sluing attachment quickly transfers the batch boxes containing the full batch from the cars to the charging skip, where they are immediately and automatically discharged by opening doors in the bottom of the boxes.

THE SKIP IS BIG ENOUGH FOR A TRUCK TO BACK INTO IT AND DISCHARGE ITS LOAD OF 56 CUBIC FEET OF AGGREGATE

Double sets of cables are placed on the charging skip, each one of which is sufficiently strong to hoist the load. The skip cannot drop if one cable breaks. The skip is raised in 15 seconds to an angle of 55 degrees, where an automatic brake stops and holds it in the charging position. An auxiliary water-tank is furnished, which safeguards the water-supply at all times.

This new 32-E mixer is of typical "heavy-duty" construction. The rigid main frames, 6 feet wide and 12 feet long, with 15-inch side-channels and 12-inch cross-channels supporting the upper frame, is built to withstand the shocks and destructive distortions to which all heavy machinery is subjected.

The mixer is mounted on Koehring-designed full-length multiplanes with forward and reverse traction, and it embodies all the automatic actions of charging, discharging and distributing characteristic of the smaller Koehring pavers.

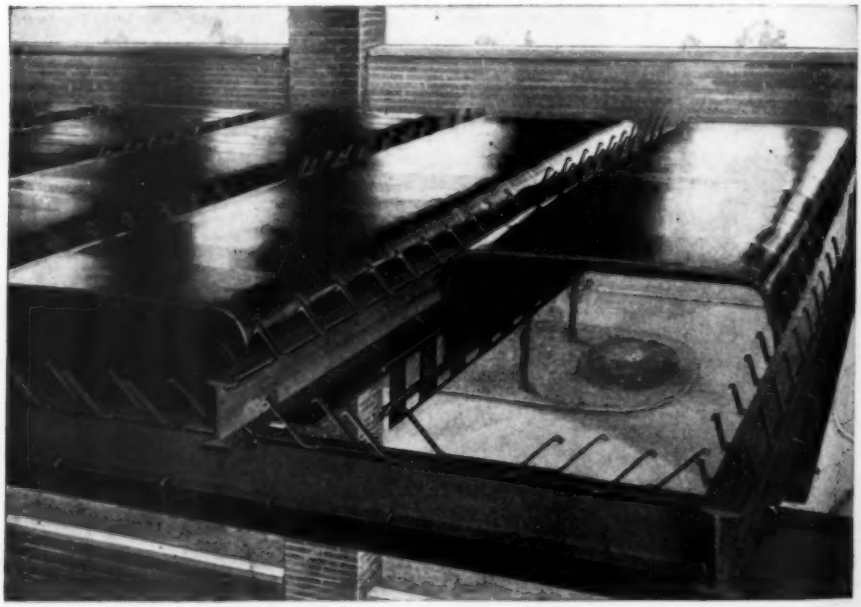
These mixers are now in the hands of some of the biggest road contractors and are said to be making big profits. A contractor must have the necessary organization and equipment to keep a continuous stream of material pouring into this Goliath of mixers to make its operation profitable. A mile of concrete road completed in four days is the average performance of this new giant paver.

Economy in Reinforced Concrete Construction

New Type of Construction Combines Self-Sustaining Features of Structural Steel with the Steel Economy of Reinforced Concrete

A NEW form of construction has been developed within the last few years by the Truscon Steel Company, Youngstown, Ohio, which merits the attention of builders. This construction combines the self-sustaining feature of structural steel with the steel economy of reinforced concrete. It is known as Truscon-I construction. Although a new idea in construction, there are no new untried principles involved. It is merely a new combination of old materials with an added factor of safety, because a greater stress is developed in this type of construction than in a structural steel beam and correct installation with proper distribution of reinforcement is assured.

Truscon-I construction is a series of I-beams



TRUSCON-I CONSTRUCTION BEFORE CONCRETING, SHOWING THE BEAMS AND GIRDERS AND REMOVABLE STEEL FORMS

It should be noted that the steel forms are suspended from the I-beams and no other forms are required in this type of construction

with the top flange sheared to form rigidly connected diagonals extending into the concrete above. These I-beams are thus integral with the concrete, making a unit of the reinforced concrete beam and slab. A complete system of removable steel forms which are suspended from the I-beam is provided. Thus, they serve the double purpose of providing supports for the forms until the concrete is set, and of rigid reinforcing for the completed reinforced concrete structure. The only centering is usually one upright support at the center of the span.

This new type of construction thus eliminates the veritable forest of timber required for the ordinary reinforced concrete job. The I-beams support the removable steel forms and ordinarily require only one row of upright supports in the middle of the bay. Thus the entire floor space is practically free for storing materials and carrying on the work of other building trades. Furthermore, owing to the fact that the forms are supported, construction can be installed on two or three floors at one time. The simplicity in placing the forms, as shown in the accompanying illustration, with their early removal, adds to the speed of construction.

In an emergency, the Truscon I-beams themselves are claimed to be strong enough to carry the dead load without failure, so it is practically impossible to have a collapse with this type of construction. The carrying capacity of the I-beam by itself is an added strength which is ordinarily not computed in the calculations. On account of the fact that the I-beams carry the dead load, it is possible to remove the slab forms in a comparatively short time, thus hastening construction and saving expense. The cost of Truscon-I construction is low because of the saving of material and labor. Compared to structural steel, it saves a large percentage of the tonnage, and compared to reinforced concrete, it saves in forms and centering as well as in the labor of installation.

Colored Concrete Floors

Helpful Information for Builders Who Are Called Upon to Lay Concrete Floors, Particularly in Residences and Offices

THE demand for a satisfactory concrete floor in colors has been voiced for many years by architects, engineers, contractors and owners. It has always seemed that the obvious advantage of concrete for floor purposes should be carried a step further to include the use of colors. The Master Builders Company, Cleveland, Ohio, some time ago introduced its red metallic hardener. This product has been used extensively where a red concrete floor was called for, but did not entirely solve the color problem.

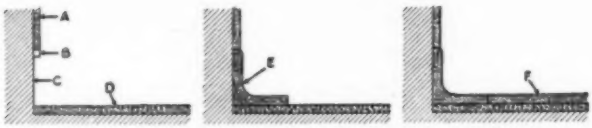
After considerable research and careful consideration of the problem, this company has perfected a product that it calls "Colormix," which employs a brand-new principle in coloring concrete. Instead of being a dry color mixed with sand and cement, with the consequent lack of uniformity and proper color, which must be the inevitable result of such a method, Colormix acts as a dye to the gaging water. It naturally follows that when the gaging water is dyed a color, there is a complete distribution of the color throughout every particle of the mass, resulting in a deep, uniform color, integral in the floor and not merely a surface coating.

This material is also a hardener and waterproofer. In the past when ordinary watercolors were used, not only was the wearing surface actually weaker and less resistant to wear, but the colors faded out, resulting in unsatisfactory floors. It is claimed that Colormix produces a true, uniform color without weakening the tensile or compressive strength of the floor, and that it contains elements which, while absolutely harmless to the cement itself, produce ideal troweling conditions, making it possible to finish these floors in record time.

TILE RED FLOORS WITH BATTLESHIP GRAY COLORMIX JOINTS IN ST. LAWRENCE SCHOOL, MINNEAPOLIS, MINN.

While this process has decided advantages, the company warns users that Colormix requires care and common sense in its use. Where it is used, all plastering and similar staining work should have been completed. It must be used in the exact quantities specified and mixed and laid as directed.

This coloring material is made at present in



INSTALLING A SANITARY CEMENT BASE

The base is installed after plastering is done and before the floor is laid. The plasterer leaves the job as shown in 1: A is plaster; B, wood strip; C, rough wall; D, rough floor. 2. After base is installed; E is cement base. 3. After floor is installed; F is finished floor

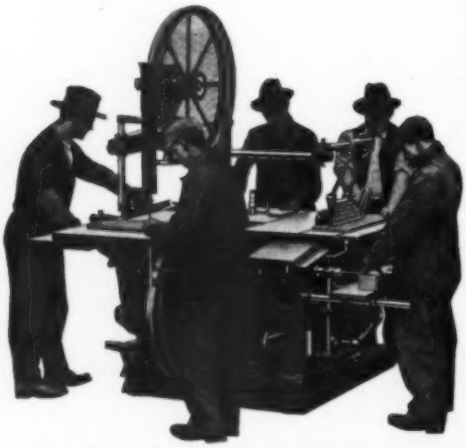
seven colors—tile red, battleship gray, buff, white, black, linoleum brown, and nile green.

The application of Colormix floors is almost unlimited. They are suitable in the case of residences, for terraces, sun porches, amusement rooms, laundries, basements, swimming pools, conservatories, pergolas, stairways, and the like. In schools they are used for corridors, stairways, laboratories, toilets, swimming pools, swimming pool rooms, mechanical arts rooms, offices, etc. In hospitals, churches, office buildings, public buildings, store buildings, hotels, clubs, theaters, restaurants, and in many other buildings they find similar application, giving a permanent concrete floor with a definite unfading color.

A Universal Wood-Worker for Contractors

A Machine Which Does Five Distinct Jobs at the Same Time Independently

EVERY building contractor wants to save money, either in labor or through being able to purchase materials more cheaply. The new model Crescent universal wood-worker made by the Crescent Machine Company, Leetonia, Ohio, makes it possible for a contractor to save considerably in labor, also eliminating the purchase of many finished wood items. This machine consists of a band-saw, a jointer, a saw table, a borer and a reversible single shaper. All these units are mounted on a substantial base, and each unit is provided with an endless leather drive belt so that the only additional belting needed is that from the line shaft to the main drive pulley. The machine may be belted from below or from the front.



FIVE MEN USING WOOD-WORKING MACHINE AT ONE TIME

The band-saw is either 26 or 32 inches in diameter. The table tilts to an angle of 45 degrees, and has a scale and pointer to indicate the degree of angle. The table may be securely locked in any position.

There is either an 8-inch or a 12-inch jointer, which is complete with tilting fence and may be used over the entire width of the table. The tables are rigidly supported and may be adjusted independently of each other. The rear table has an offset for rabbeting.

The shaper is entirely independent of any other unit of the machine. The spindle may be raised to 7 inches above the table or may be entirely lowered beneath the table. It will take a knife 4 inches wide between slotted collars. The spindle rests on ball thrust bearings to reduce friction. The shaper may be left off if not wanted.

The saw table may be raised and lowered to suit for cutting through different thicknesses of material. The top may be tilted to any angle up to 45 degrees by means of a hand wheel, worm gear and rack. The ripping fence may be used on either side of the saw, and when used on the right may be tilted to an angle of 45 degrees. The cut-off fence may be used on either side of the saw, and is adjustable for any angle up to 45 degrees, right or left miter.

The borer is conveniently placed entirely separate from any other unit of the machine. The table may be raised and lowered by means of a screw and crank to suit for boring holes at a proper place in a piece. The table has a horizontal adjustment to and from the bit. The accompanying illustration shows this wood-worker being used by five men at the same time.

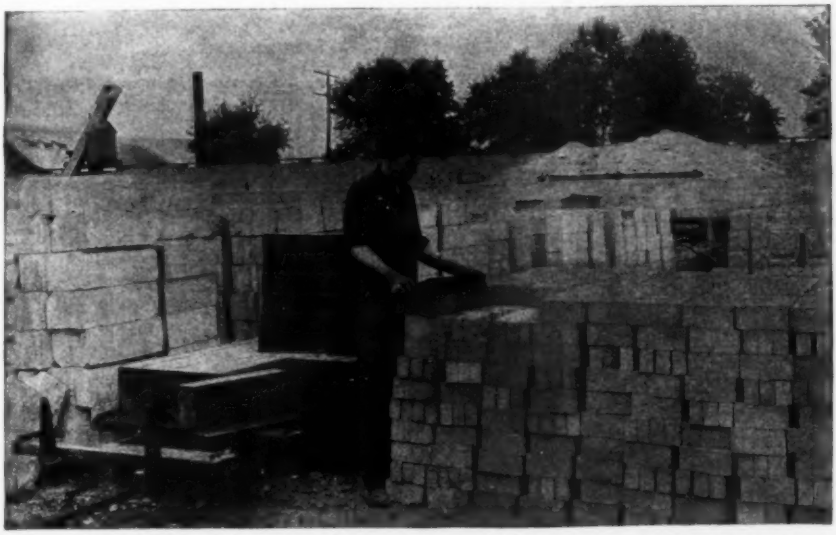
Multiple Molds for Casting Concrete Brick

Remarkable Field Opened Up by the Development of the Zagelmeyer System

THE process of casting concrete bricks in multiple molds, 400 at a time, and making possible the handling of the cast bricks in units of ten at a time, has been perfected by the Zagelmeyer Cast Stone Block Machinery Company, Bay City, Mich. It is possible through this process for one man to make as many as 4,000 bricks a day. Experiments have been conducted for nearly ten years by this company in the effort to develop a practical method of manufacturing concrete bricks at a cost which would make the use of concrete bricks commercially economical. Two years ago the present molds were perfected, and the manufacture of concrete bricks was begun on a commercial scale in the large concrete block plants operated by this company.

The Zagelmeyer system of multiple brick molds consists of 40 open-end units, each holding ten bricks, or 400 molds in all, mounted on a roller-bearing truck. The molds can be quickly set up on the truck and the truck run under a concrete mixing machine, where the slush concrete is poured directly into the brick molds. The truck is then run into heating tunnels or kilns, heated with steam pipes and allowed to remain in a temperature of 120 degrees for eight to ten hours before removal. This allows the concrete to take its initial set before the bricks are removed from the molds. The length of time required for the set to take place and the bricks to harden sufficiently to permit removal depends upon the temperature of the air. At ordinary summer temperature, without the heated tunnels and with fairly quick-setting cement, the bricks can be removed in from 20 to 24 hours, so that the molds can be used once each day in any event.

After the concrete has taken its initial set, the bricks are ready for removal and final curing. The only handling the bricks receive during the entire process of manufacture is when they are taken from the molds, and this is simplified by handling ten bricks at a time in the ten-unit molds. The workman lifts out the unit and deposits the ten bricks in a pile in one operation without handling each individual brick, thus saving considerable time.



REMOVING CONCRETE BRICK FROM MOLDS IN BLOCKS OF TEN, THUS REDUCING HANDLING COSTS

Owing to the fact that the bricks are made from slush concrete, a mixture is obtained which becomes perfectly dense and free from pores, thereby insuring an absolutely waterproof brick of much greater crushing strength and considerably greater hardness than most other types of brick.

Tests of Concrete Brick Walls

Columbia University, New York, has run a series of tests on masonry piers made of concrete brick and also of common clay and shale brick, which have brought out some interesting facts.

A series of piers, 12 x 12 x 40 inches in size, was built by usual job methods. Some were

built of concrete brick, supplied from various sources, some were built from sand lime brick, and the rest were built of ordinary common clay and shale brick as supplied to the New York market. All were tested under compression at several ages and the effect noted.

The average compressive strength of the series of concrete brick was 3,522 pounds per square inch, while the average compressive load at which three piers failed when built of the same brick was 276,000 pounds. The clay brick used in the test were those of a make having an average compressive strength of 3,578 pounds per square inch, which was slightly greater than that of the concrete brick above mentioned. Three piers built from this clay brick failed at an average load of only 139,000 pounds. These figures are said to give a fair sample of the numerical results obtained.

Another and equally important discovery was made and was directly dependent on the foregoing results. The type of fracture obtained on the failure of each pier showed that the concrete brick gives such a perfect bond that the full monolithic strength of the pier was obtained and that the fracture was of the cone type common with monolithic concrete. The clay brick, on the other hand, gave but imperfect bond with the mortar, and the failures were a direct result of the failure of the mortar bond. This means that cracks were developed at some joint and continued until a shearing or bending action took place in individual bricks, resulting in a fracture of the brick that bridged or overlapped the motor joint that had at first failed.

According to the abstract of this report appearing in the *American Contractor* and prepared by the Portland Cement Association, this demonstrated conclusively that the great strength of certain clay bricks is not utilized in a structure, but that the strength of the mortar bond is the factor that will govern the strength of the masonry structure as a whole. It seems to controvert the old theory that the strength of an average brick in a masonry structure will govern the strength of the structure. It points out that a weak brick will often build a better wall than a strong brick if the mortar bonding properties in the weak brick overbalance the bonding properties of the stronger brick.

The good bonding properties of concrete brick seem to be due to three factors: first, the brick and the mortar are of similar material; second, concrete brick are of the exact porousness that would insure the best setting of the mortar; and, last, the surface of the concrete brick is of the right texture to afford a good holding surface for the mortar.

A Machine That Speeds Up Gravel Heating

New Heater and Dryer Has Unusually Large Heating Area

BY using a simple principle combining the power of heat and ventilation, gravel is dried and heated very quickly and thoroughly in the new Littleford No. 74 gravel heater and dryer, which is manufactured under the C. A. Mullen patent by Littleford Brothers, 500 East Pearl Street, Cincinnati, Ohio. The machine is made in two sizes and has a capacity of 2 or 4 tons of gravel per hour. It will heat all kinds of crushed stone and gravel, but because of its construction cannot be used for sand. It is adaptable for use by paving and building contractors, roofers, street railways, maintenance departments and others. Where winter concreting calls for large quantities of hot material, it is claimed that this heater is indispensable.

A HEATER OF VALUE FOR WINTER CONCRETING

The machine is made entirely of plate steel and consists of a large fire chamber with sloping walls of perforated steel extending upward to a point at the base of the charging hopper. At different levels, but uniformly spaced from these walls, are additional perforated walls or flights. In operation, material to be dried is loaded into the hopper at the top, from which it feeds by gravity into the open flights on both sides of the heater. As it is suspended in a thin layer against the perforated sides of the fire chamber, the heat passes directly to and through it, carrying away all moisture. Hot, dry material continually feeds to the base, where it can be easily removed.

This equipment is mounted on heavy steel wheels 16 inches in diameter and axles which are machine turned and fitted with standard axle nuts. A suitable handle is provided for drawing it about.

Trenching for the 25th Street Sewer, Borough of Queens, New York City

Steam Shovel Plays Important Role in Digging Wide Trench

A COMBINED sanitary and storm-water sewerage system is now being constructed by Booth & Flinn, Ltd., in 25th Street, North Beach, for the borough of Queens, city of New York. This work is part of the modern sewage disposal project recently adopted by the city of New York as a necessary step in the development of this borough. The section now under construction consists of a concrete cut-off chamber, junction chamber, overflow chamber, and screen chamber, the latter equipped with two 14-foot Riensch-Wurl revolving screens, together with 1,250 feet of reinforced concrete storm-water sewer, 14 feet 7 inches x 8 feet, and 1,100 feet of reinforced concrete sanitary sewer, 9 x 9 feet.

The two sewers are located side by side, and are being constructed in a single trench, excavated by open cut. The design provides a space of 3 feet 8 inches between the two sewers, so that, with sheeting and bracing, the trench is 35 feet wide. The maximum depth is 38 feet, with an average depth of about 26 feet, and the material excavated is sandy clay on top with fine, hard sand below, with the trench bottom from 5 to 7 feet below high water.

This work is located in an undeveloped section, 25th Street being a proposed thoroughfare at this point, with ample room for casting the excavation on the trench bank. With this condition in mind, the contractors have adopted a method of excavation that is seldom practised in this section of the country, especially within the city of New York on sewer trenches, that of the dragline excavator. For this purpose an Osgood ¾-yard heavy-duty dragline is being used, operated by steam power and equipped with a 45-foot boom and a ¾-yard Page dragline bucket. This dragline is fitted with continuous tread traction and rides on top of the cut and within the lines of excavation, somewhat to one side, and in operation drags the excavation in a circular fashion, with and across the cut. The material is loaded into motor trucks without any spilling, and between trucks is cast on the bank, well back from the cut. The excavation is cast only on one bank, the opposite one being kept clear for

DRAGLINE WORKING IN OPEN SEWER EXCAVATION ON 25TH STREET, BOROUGH OF QUEENS, NEW YORK CITY

passage of a traveling derrick for use in excavating the trench bottom.

The dragline excavation is 40 feet wide at the top, 35 feet wide at the bottom, and digs from 13 to 21 feet deep, depending on the stiffness of the soil, as the trench is not sheeted until after the dragline excavation has been made. This dragline has also been used in excavating, with a drag bucket, for the bottom in the sheeted sections, in sand and water, working between the bracing. The average progress has been about 350 yards, in place, for an 8-hour day.

The two sewers are being concreted by means of Blaw-Knox steel forms, with a traveling mixer plant located on top of the trench, while the backfill is placed from the cast spoil.

This work is under the direction of Frank Perrine, Engineer of Sewers for the Borough of Queens, and M. L. Quinn, General Superintendent for Booth & Flinn, Ltd., and William Griff, Resident Superintendent.

New Floor Surfacer a Labor-Saver

Electric Motor, Flexible Shaft and Cup-Grinding Wheel Turn the Trick

THE machine illustrated herewith has been designed to make concrete floor surfacing easier and to produce a better and smoother job than by previous hand-grinding methods. In the new Illinois Merchants' Bank Building, Chicago, Ill., one of these machines with a 5 x 2½-inch cup-wheel did the work of grinding down a conduit covering more quickly than four men formerly accomplished it. The machine has been operated steadily on an 8-hour basis without any trouble. The grinding wheels, which are mounted on a flexible cable attached to an electric motor mounted on a small movable platform, are good for several days' service and are easily and cheaply replaced when worn out. This outfit, made by the R. G. Haskins Company, 620 West Monroe Street, Chicago, Ill., has met with favor among building contractors for this type of work.

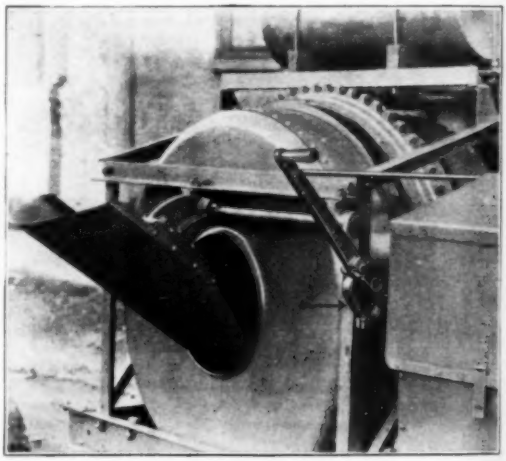
FLOOR SURFACER AT WORK IN THE NEW ILLINOIS MERCHANTS' BANK BUILDING, CHICAGO

Chute Mechanism for Non-Tilting Mixer

Lever Operating the Chute Is Automatically Locked

ONE of the most recent improvements made on the 7-S mixer of the T. L. Smith Company, Milwaukee, Wis., is a more simple mechanism for operating the discharge chute. The operating lever is pivoted to a short arm that is keyed to the shaft to which the chute is attached. When the operating lever is moved, a small roller attached to the end of the lever follows the outline of the cam that is bolted to the mixer frame. Except for the rod which extends across the mixer to enable the chute to be operated from the other side, these few simple parts constitute the complete discharge operating mechanism.

In the illustration the lever is shown at its extreme forward position. The chute is locked securely in the position for mixing and is where it cannot interfere with the mixing action. Pushing the lever back moves the chute into the discharging position. In the full discharge position the locked chute need not be held.



NEW CRANK AND CAM ARRANGEMENT FOR OPERATING CHUTE OF CONCRETE MIXER

Construction Company Finds Road-Roller-Tractor a Money-Saver

All-round Gasoline-Driven Machine Put to Many Uses by Carbondale, Ill., Contractor

THE Montague Construction Company, of Carbondale, Ill., has found that the use of a gasoline road-roller-tractor has not only speeded up its work, with considerable saving in labor costs, but has also made it possible for it to turn out a better class of work.

Recently this company was pushing a paving contract to the limit at Johnson City, Ill., and every piece of machinery and every man on the job was on the jump. One of the busiest machines was a 20-35-horse-power road-roller-tractor made by the Avery Company, Peoria, Ill., which was chugging back and forth rolling down the subgrade before the concrete was laid. The superintendent stated that the machine was small and easily handled and could turn around in a short space, was easier to operate and care for than a steam roller and cost no more for fuel, in addition to being able to pull a grader just as easily as a common tractor and having the added road roller feature.

AN AVERY 20-35 HORSE-POWER TRACTOR WITH ROLLER ATTACHMENT ROLLING DOWN THE SUBGRADE IN A PAVING PROJECT IN JOHNSON CITY, ILLINOIS

The road-roller-tractor with its wide roller and broad rear wheels traveled back and forth over the subgrade, leaving it hard, firm, and free from air pockets. After the operator had finished up this piece of work, he drove the machine a few blocks to where the concrete had been laid and the sand and brick had been placed, and made a few rounds, taking the bumps and depressions out of the street, leaving it as smooth as could be asked.

E. R. Montague, President, Montague Construction Company, wrote to the Avery Company in regard to this all-round, versatile machine as follows:

"We have used our improved 20-35 road-roller-tractor in street construction in Johnson City, Ill., since we purchased it on May 21 of this year. We like our machine fine. On this job we rolled our subgrade before laying the concrete and the brick. After laying the brick, we then rolled the brick down in fine shape. We did not do any grading on this job but intend using the machine for grading the street or road and then use it for rolling, too.

"We believe the machine is just the machine for road construction work. We would most certainly recommend it to any contractor who needs a road roller for his work."

The Ways of the Building Trades

SOME one supplies us with this little narrative of personal experience. We believe it to be authentic and we are quite sure our readers will agree that it deserves wide publicity.

A man in a down-town skyscraper in New York City wanted to cut a door through a wall. This is what happened:

1. Management of building asked for estimate of cost for cutting the door through the hollow-tile partition.
2. Estimator looks over the proposition.
3. Estimator comes back and quotes price.
4. Management instructs estimator to go ahead.
5. Written order prepared and mailed, according to requirement.
6. Supervisor comes and marks out space for the cutting.
7. Mechanic comes with sledge hammer and smashes hole through the wall.
8. Helper comes and removes débris.
9. Carpenter comes and sets up wooden door frame.
10. Mason comes and fills in around the frame with tile.
11. Cleaner comes and removes débris.
12. Tile-setter comes and places door-sill and marble base-board.
13. Carpenter comes and attaches door to

wooden frame.

14. Plasterer comes and covers over tile work and fills in the holes about the door.

15. Metal worker comes and sets up door frame and repairs chair rail.

16. Decorator comes and calcimines wall.

17. Cleaner comes and removes rest of débris.

18. Decorator removes some paint spots, but leaves some others.

19. Two weeks later decorators come for their ladders and remove them.

20. Bill received—$150.

21. The management mails check and privately estimates the value of the worry and trouble of trailing the successive relays of workmen at $100. Total—$250 for a 36-inch door. Total elapsed time—three weeks from items 1 to 18, five weeks from 1 to 19.

Is this an honest and fair illustration of the way things are done nowadays in the building trades? It is. —*Barron's.*

A Light-Weight Acetylene Generator

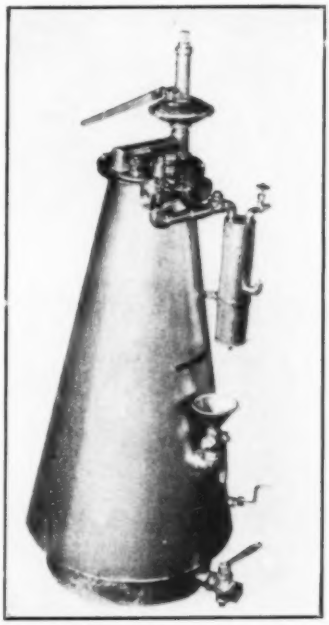
New Welding Generator Greatly Adds to the Convenience of Welding Repairs on Job

A NEW type of generator which is especially handy for contractors who use oxyacetylene apparatus has recently been brought out by the Alexander Milburn Company, Baltimore, Md. This generator supplies gas when and where needed and does away with the not infrequent delays and the occasional difficulty of securing tanks of acetylene. It will operate any make of welding or cutting torch.

The generator is of 30 pounds carbide capacity, or the equivalent of 150 feet of cylinder gas. It is simple to operate, having few parts, and operates automatically without any clock or motor. The steel body is welded throughout, insuring a gas-tight generator.

The generator is 2 feet in diameter at the bottom and 12 inches in diameter at the top, standing 5 feet 3 inches high. It weighs 200 pounds when empty and has a shipping weight of approximately 225 pounds. The hopper and head are in one unit. The cast head houses the entire feed control. The generator can be quickly and easily recharged with carbide and has an oversize sludge outlet, permitting quick removal of the spent carbide. The generator uses ¼- by 1/12-inch carbide, producing, purifying and delivering gas as and when required at an approximate cost of one cent per cubic foot.

A number of these portable acetylene generators should be on every job where night work is to be carried on or where there may be emergency night work.



PORTABLE ACETYLENE GENERATOR FOR CONTRACTORS

Large Mixers for Hydraulic Dam Projects

Shipment of American Machinery for Foreign and Domestic Hydro Projects

TWO 4-cubic-yard (112-S) Smith tilting mixers, made by the T. L. Smith Company, Milwaukee, Wis., have recently been shipped for use on the hydraulic dam project at Hebertsville, Canada. This dam project is one of the largest on the American continent. The mixers are duplicates of the two that were used at the Muscle Shoals Dam and are claimed to be twice as large as any other concrete mixers ever built.

Four 56-S, 2-cubic-yard mixers of the same type are now being built for use on the Wilson Dam project across the Tennessee River at the foot of Muscle Shoals on which two of the Smith 4-yard and two 2-yard tilting mixers were formerly used. The Wilson Dam is claimed to be the most significant effort in construction undertaken by the Government since the building of the Panama Canal. Under the direction of the War Department engineers, the largest concrete form in the world is being rushed, which upon completion will be the largest hydro-electric installation yet achieved. There will be 1,260,000 yards of concrete.

The Nation's Road-Maker

More miles of good roads and streets are being built and maintained all over the world by "Caterpillar"* Tractors than by any other machine or method. On important engineering projects, property development, reclamation and dirt moving jobs of every kind, "Caterpillar" Tractors are used extensively. Counties, cities, contractors and engineers pronounce the "Caterpillar" unequalled in *performance, real economy* and *continuous power.*

H. C. King, County Engineer
Okmulgee, Oklahoma, says:

"To show you what we think of Holt tractors, we have 14 of them working on our roads at present and contemplate purchasing two more. We find them the most economical power for heavy hauling and grading and estimate they reduce the cost of our grading thirty to fifty per cent. By actual records, the maintenance is very little, compared to the amount of work done. We find they give most satisfactory service. I used Holt tractors in France in hauling heavy artillery and always found them ready to go."

Contractors, engineers and road officials who use "Caterpillars" get *real performance*—and profit accordingly. In oil field and mining transportation, logging, cross-country freighting and tractive jobs of every kind the "Caterpillar" provides the most dependable and economical power. Let us figure with you on your transportation-power requirements. Our booklet, "The Nation's Road Maker," sent upon request.

** There is but one "Caterpillar"—Holt builds it*

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Chicago, Ill.
Minneapolis, Minn.
Indianapolis, Ind.
Canadian Holt Company, Ltd., Montreal

Portable Gyratory Stone Crushers

This Economical Type of Crusher Now Available in Portable Form

CONTRACTORS and engineers have for many years recognized the economy of the gyratory type of crusher for producing a cubical, finely crushed product with a minimum amount of power. The Austin-Western Road Machinery Company, 400 North Michigan Boulevard, Chicago, Ill., is now offering a complete gyratory crushing plant mounted on trucks, making it easily moved from place to place by the traction engine that is used to drive the crusher.

COMPLETE PORTABLE GYRATORY CRUSHER WITH BELT CONVEYOR

The crusher itself is mounted on a strong I-beam frame with heavy wheels having tires of ample width. The back gear drive is substantial and so arranged that the power unit is located at right angles with the plant, where it is out of the way of teams or cars bringing the gravel from the pit or quarry. The delivery spout of the crusher is in the rear of the truck, affording convenient means of attaching the elevator. The No. 2, 3 and 4 crushers have spider openings of 8 x 22 inches, 8½ x 24 inches, and 9 x 27 inches, respectively, and the following capacities in tons per hour, respectively: 5 to 10 tons, 1½ inches in diameter; 10 to 20 tons, 1¾ inches in diameter and 15 to 30 tons, 2 inches in diameter. These crushers have rigid eccentric bearings with an automatic oil system, and are claimed to be the only crushers in which the counter-shaft is supported by a bearing on each side of the driving pinion. The bearings are thoroughly protected from dust and grit by a dust-proof diaphragm above the oil cellar. The crushers are regularly fitted with chilled iron heads and concaves, and when the material to be crushed is extremely hard or abrasive, steel is recommended. Heads and concaves may be secured in several diameters and thicknesses for each size of crusher. Thus any machine can be made to furnish a large range of products simply by varying the head and concave combinations. An adjustment is provided for raising and lowering the head and shaft, making it possible to vary the size of product without changing the head or concaves and also to maintain a fixed-size product as the crushing surfaces wear after the breaking of hundreds of tons of stone.

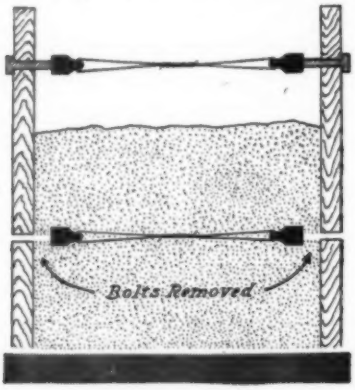
Frye Retires from Chain Belt

WILLIAM C. FRYE, for seven years President of the Chain Belt Company, Milwaukee, Wis., has retired from active participation in its affairs and has been succeeded by C. R. Messinger, Vice-President and General Manager since 1917. Mr. Frye is retiring after an active association with the company for 25 years. During this time he has occupied practically all of the important executive positions. Mr. Messinger, who succeeded Mr. Frey, became associated with the Chain Belt Company in 1917.

Little Things That Help in Concrete Construction

Malleable Iron Specialties Cut Down Time Required to Build Forms and Join Reinforcing Bars

HERE are several little devices that possess a score of uses in concrete building construction. The manufacturer, the Marion Malleable Iron Works, Marion, Ind., claims that they cut down materially the time required to build forms and join reinforcing bars, and by their simplicity and usefulness increase to

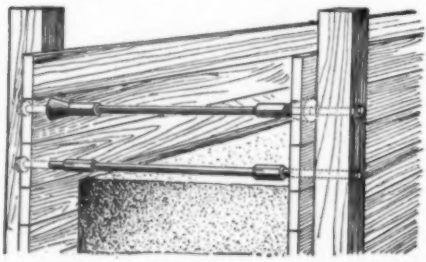


USE OF WIRE FORM TIGHTENER

a marked degree the speed of erection of concrete structures. A feature that will interest every builder is their cheapness, and as they are standardized, they may be bought by the hundred or by the barrel, and each one will be found usable and properly threaded.

Wire Form Tightener

The wire form tightener illustrated above is attached to a wire slipped through from one side of the form, and a bolt is screwed into it

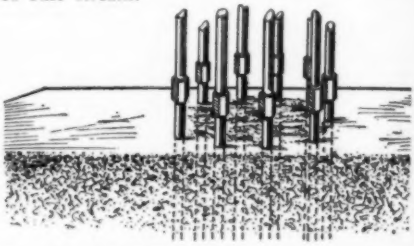


USE OF SPREADERS AND COUPLINGS IN FORM WORK

Above.—Spreader used with couplings and bolts. Below.—Couplings used with bolts

A WIRE FORM TIGHTENER

from the face side. The bolt makes it possible to obtain any degree of tension and to bring the form into perfect alignment. After the concrete is set, the bolt is easily withdrawn, and the small hole may be stopped with a slush of concrete, leaving a smooth surface to the wall with no wires protruding and no possibility of rust streaks.



COUPLINGS USED FOR BUTT JOINTING STEEL

Bar Couplings

Hexagonal threaded bar couplers are adapted to several important uses. When couplers are used as a form tie in conjunction with a spreader attachment, it is possible to secure absolute rigidity and perfect adjustment on particular, exacting work. On each end of a threaded rod of proper length to span the form are placed a spreader and a coupler. Then, the stud bolts are passed through from either side of the form and screwed into the couplings, thus bringing the form to exact adjustment. When taking down the forms after the concrete is set, all that is necessary is to remove the stud bolts and spreader, letting the rod and couplers remain in the wall. The holes are then filled with a dash of cement.

For continuous reinforcement in either column or floor work, these couplings are very effective. Their use not only saves time over tying with wires and other methods, but by butt-jointing the steel the strength of the reinforcing fabric is materially increased. These couplings fill the Government requirements for continuous reinforcement on bridge and dam work.

An Air-operated Hoist for Draglines

An Ideal Unit for Use in Gravel-Pits Where Compressed Air at 50 Pounds Pressure Is Available

A LIGHT-WEIGHT, well-balanced, readily portable hoist which is powerful for its size, develops a high starting torque and is simple and easy to operate for special use in slusher mining or for the operation of draglines, has been recently placed on the market by the Denver Rock Drill Manufacturing Company, Denver, Colo., under the name Model 300 Turbro Waughoist.

Exhaustive tests have been made to determine the proper rating of the hoist. The loads on these tests were measured by a tractometer attached to the hoist rope, thereby making unnecessary the usual allowance for friction. At an air pressure of 50 pounds, at the hoist, an average of 10 horse-power was developed. With a 1,600-pound rope pull, the rope speed was 295 feet a minute, and at 2,200 pounds rope pull, 118 feet per minute. This model 300 weighs only 495 pounds, or 49½ pounds per rated horse-power developed by the hoist. The transmission gears are placed at the end of the hoist opposite the air motor, thereby giving a good distribution of weight.

The rope speed of a scraper hoist or dragline should be flexible, to permit slow speed while the scraper is taking its load and being dragged in, and higher speed for returning the scraper to its outermost position. The hoist has a ¾-inch diameter air inlet which will furnish sufficient air at 50 pounds pressure, at the hoist, to develop an average of 10 horse-power. The 1¼-inch inlet which can be obtained by removing the ¾-inch bushing is only used when operating at very low pressures or where additional power is required. The 1-inch air hose with a ¾-inch connection at the hoist is recommended for use with this machine. If the air pressure at the pipe line is high, a ¾-inch hose will be sufficiently large to furnish all the air required. Drum brakes are provided for keeping a slight tension on the rope while unreeling.

The hoist engine itself is in reality an air turbine, consisting of two steel rotors revolving within an air-tight compartment. The rotors are carefully balanced and revolve freely, eliminating the vibration common to many types of hoists. This construction permits of no dead center, so that it will start in any position.

A turntable is provided for use with the hoist when desired. It permits shifting the hoist easily and quickly to any desired angle by loosening two clamping bolts. The turntable increases the height of the machine 2¼ inches, and the weight by 92 pounds. A turntable is not required for efficient hoist operation, but it is very convenient under some operating conditions.

A COMPRESSED AIR HOIST FOR OPERATING SCRAPERS

The manufacturers claim that the No. 300 Turbro Waughoist is operated in every position with equal efficiency. The hoist is secured in the desired position, the air hose connected to the hoist air inlet, the lubricator of the air motor filled, and the oil level in the gear housing tested. Then the hoist is ready to operate. The throttle valve is moved forward to work the drag-rope drum, and backward to work the tail-rope drum. The throttle valve is automatically returned to the neutral position and locked when the operator's hand is removed from the throttle. The drums are equipped with external-contracting-type brakes operated by small hand wheels. A slight tension should be kept on these brakes at all times to prevent the drums from running too fast when unreeling. The air motor is fitted with two 1¼-inch exhaust plugs. These plugs should be used when the hoist is operated with light loads and the full horse-power of the hoist is not needed. For the usual scraping operations the exhaust plugs should be removed. The air screen should be inspected frequently. This screen is located in the air inlet and may become clogged with oil and dirt, carried by the air, materially reducing the horse-power developed.

Two Kinds of Discontent

There are two kinds of discontent in the world—the discontent that works, and the discontent that wrings its hands. The first gets what it wants, and the second loses what it has. There's no cure for the first but success; and there's no cure at all for the second.

—Gordon Graham.

A New 1¼-Yard Heavy-Duty Steam Shovel

A Full-Revolving Type Machine with Continuous Tread Mounting, Made by Well-Known Manufacturer

A NEW 1¼-yard heavy-duty revolving steam shovel has been added to the line of the Osgood Company, Marion, Ohio. This steam shovel has horizontal hoisting engines, submerged tube type vertical boiler, a centering gudgeon for connecting the main body casting to the path gear, simplified continuous tread and traction mounting, a double-geared shipper shaft, an automatic trip rope tension, etc.

OSGOOD 1¼-YARD SHOVEL WITH CONTINUOUS TRACTION TREAD

The hoisting, swinging and crowding engines are of ample size and stroke to furnish a surplus of power for all ordinary uses. The entire machine is designed for heavy work, with oversized shaftings and large bearing surfaces at points of great stress. The boom and dipper handle are made of white oak timber shrouded with plate steel and the whole securely bolted together, forming solid units. The dipper handle is fitted with manganese steel racking which operates over manganese steel pinions on the double-geared shipper shaft. The double-geared shipper shaft insures equal application of power to the dipper handle racks, thus eliminating to a great extent side strain and twisting. The thrust of the dipper is also more positive. The dipper is of full 1¼-yard capacity with manganese front and is of substantial construction throughout to give the maximum service in heavy material.

The hoisting and swinging units are assembled above deck on the upper body center member, a one-piece open-hearth steel casting. This type of construction is claimed by the manufacturers to insure absolute rigidity of the upper body, which rotates on conical manganese steel rollers set in the upper body frame. These rollers are adjustable and removable without jacking up the body. A hub projecting down from the upper body casting fits over a hub which extends upward from the path gear, forming a centering gudgeon which eliminates all possibility of the upper body's sliding off the rotating gear and also relieves the vertical propelling shaft of side strains in swinging.

The machine can be equipped with high-lift boom or trenching dipper and is especially adapted for use with clam-shell or dragline buckets or as a crane. The drums furnished for clam-shell or dragline equipment are of sufficient power to operate the bucket with single lines, thus greatly speeding up the operation as well as reducing wear on the lines and eliminating a set of sheaves at the bucket connection.

A Portable Pumper for Mounting on Fords

Small Centrifugal Unit Adaptable for Construction and Road Work and for Pumping Out Trenches

A SMALL pumper has been developed as an attachment for Ford cars which should prove particularly helpful to contractors. The Ford is practically universal in construction work, as it is found on almost every job. One or two of these machines equipped with a Barton pumper which is mounted on the frame of the car and driven by the crank-shaft, should prove a helpful unit in many cases of flooded trenches, auxiliary water-supply for road work, and other places where a dependable unit that will handle on an average of 250 gallons a minute is needed on the job.

These pumpers are especially well adapted for construction work, as they are equipped with an open runner which makes it possible to pump water containing small sticks, gravel and mud, such as a contractor is liable to encounter. The connection used between the pumper and the car is of simple construction and strong enough to carry the pump on the front end of a Ford, and it can be left on while driving with no danger of strain or breakage to the car, as the weight of the pumper is carried entirely on the frame, relieving the crank-shaft and motor of all strain. The first installation of the pump and attachment on the Ford requires about 1½ hours' work and thereafter the pump

may be connected or disconnected quickly.

This pumper will lift water by suction 26 feet and has a normal discharge capacity of 250 gallons per minute with an engine speed equal to 20 miles per hour on the road. It is designed and built for the Barton Products Company, Jackson, Mich., the manufacturers of the unit, by the American Steam Pump Company, Battle Creek, Mich., and carries their guarantee.

A New Mast Hoist Bucket Equipment

New Steel Mast and Boom Are Great Help in Concrete Construction Work

IN the past the activities of the Insley Manufacturing Company, Indianapolis, Ind., in bringing out equipment for use in the smaller concrete jobs have been confined to the wood mast in mast hoist equipment, but recently this company has brought out the new steel mast plant, which bids fair to be a great help in certain classes of concrete construction work.

The steel mast is sufficiently strong to permit tying a 30-foot boom chute direct to it, and the boom chute bridle line carrying the head end of a second 30-foot section provides a placing plant having a 60-foot radius of section without the necessity of any recourse to tripods or other chuting supports. The bracket on which the boom hinge chute rests and the bracket which takes the chute suspension lines are tied together with angles, the entire assembly sliding on the front face of the mast much after the manner of the well-known Insley Quick-Shift steel tower equipment. The mast is made in 20-foot sections so as to facilitate erection and transportation, and the members are of sufficient strength to permit running up the mast to a height of 140 feet.

The bucket is designed to take the output of either a one-sack mixer or a two-sack mixer, and the plant can be counted upon to handle from 60 to 150 cubic yards of concrete per day. The entire set of equipment is such that the contractor has at his disposal a permanent concrete placing plant of reasonable cost which, from the standpoint of first cost, plus erection and efficiency of operation, compares favorably with the older wood hoist tower equipment.

STEEL MAST HOIST FOR CHUTING CONCRETE, USED BY J. F. RUSSELL & COMPANY, BUILDING CONTRACTORS, ON THEIR ST. ANTHONY HOSPITAL JOB, LOUISVILLE, KY.

Low Bidders May Withdraw Bids Not Read

WHENEVER there is a large letting of state highway work, constructors who have equipment and organization idle naturally and quite properly inspect and prepare bids on a larger number of projects than they expect to be called upon to build. This is necessary in order for them to secure the amount of work desired. In the future in Pennsylvania when contractors find themselves low bidders on as many contracts as they feel capable of executing, they will have the privilege of withdrawing additional bids. This will protect contractors against overloading, and it will also protect other bidders from losing work through rejection of all proposals on a particular job because of the inability of the low bidder to qualify.

The Pennsylvania State Highway Commission will make a practise of checking all bids received and announcing the low bidder immediately after the reading of bids on each project.

KOEHRING CRANE EXCAVATOR

KOEHRING HEAVY DUTY

REG. U. S. PAT. OFF.

Koehring organization combines with seasoned crane experience in designing and building Koehring Crane Excavators.

KOEHRING Crane designing engineers are seasoned men of specialized experience in the crane field. They have had full unhampered swing to improve on design and construction and have done so in countless fundamentals which give the Koehring an extra margin of strength, capacity and service life.

Crane Excavator Capacities

No. 1—7 tons at 12 ft. radius. Will handle bucket up to and including one cubic yard capacity, the radius of operation depending upon the size of the bucket. Standard boom 35 ft. long, but special lengths of boom can be furnished where necessary. Four cylinder 5"x6" gasoline engine.

No. 2—12 tons at 12 ft. radius. Will handle bucket up to and including 1½ cubic yards capacity, the radius of operation depending upon the size of the bucket. Standard boom 40 ft. long, but special lengths of boom can be furnished where necessary. Four cylinder 7½"x9" gasoline engine.

No. 3—20 tons at 12 ft. radius. Will handle bucket up to and including 2 cubic yards capacity, the radius of operation depending upon the size of bucket. Standard boom 40 ft. long, but special lengths of boom can be furnished where necessary. Four cylinder 8½"x10" gasoline engine.

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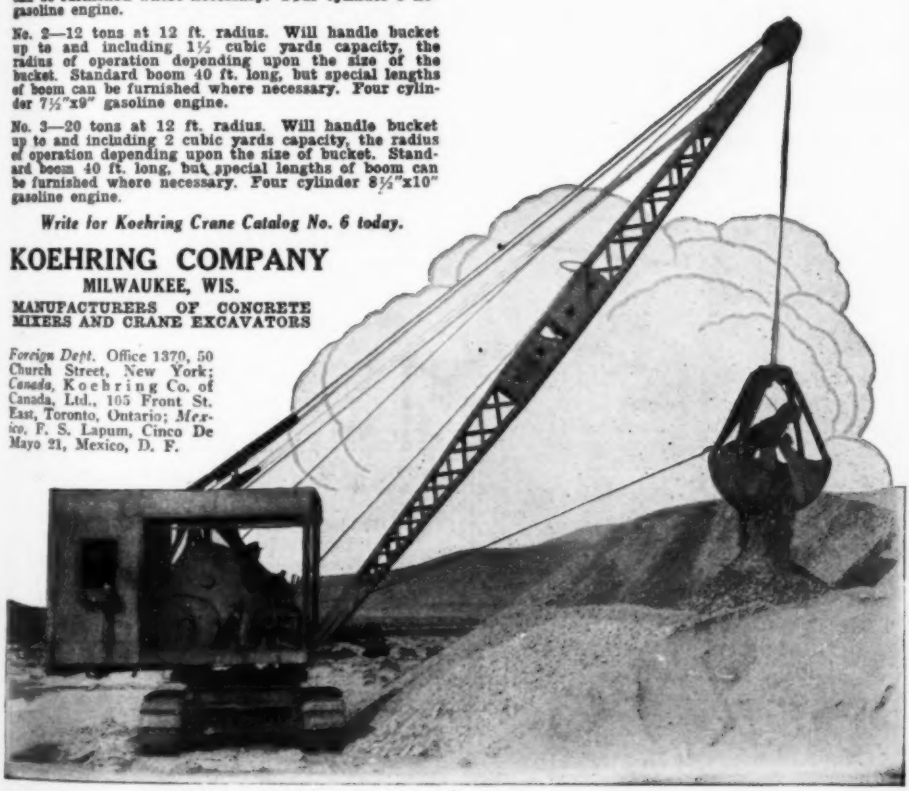

Distributors of Contractors' Equipment

THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed.

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The Ironton Engine Co., Storage battery locomotives.
Insley Mfg. Company, Concrete handling equipment, steel derricks, industrial cars.
Mead-Morrison Mfg. Co., Hoists and Grab buckets.
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